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BIOLOGICAL SUGGESTIONS.

MIMICRY.

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(Continued from p. 470.)

To revert to "active mimicry,"* and to render our signification of the term as clear as possible, we will first adduce an instance given by that competent lepidopterist, Georg Semper:—"During the last ten years the well-known white-leaved variety of *Acer negundo* has been largely planted in gardens in Hamburg, and since this the common White Cabbage Butterfly has accustomed itself to settle by preference on this shrub. It is then extremely difficult to distinguish the butterflies as they sit on the leaves, their yellowish colour being lost in that of the leaves."† Had Hamburg been a locality in some *terra incognita*, and visited by a travelling naturalist of observing faculties, who can doubt—and why should surprise be felt under the circumstances—that this observation would have appeared, and been recorded, as an

* This term receives no support in the best work on Birds yet written. Prof. Newton maintains that mimicry must have the prefix "unconscious," "which in every department of Zoology should be always expressed or understood"; and, again, wherever mimicry is not only possible, but even probable, "we must always remember that however produced it is *unconscious*." ('Dictionary of Birds,' edit. 1899, pp. 572 and 575.)

† Cf. Karl Semper's 'Animal Life,' p. 466.

instance of passive mimicry? A similar observation was communicated to Mr. Trimen by Mrs. Barber. She was impressed by the behaviour of a male of the conspicuous butterfly, *Papilio cenea*, which twice deliberately selected in her garden, as a resting place during a shower of rain, a shrub whose pale yellow and brown seeds and flowers entirely agreed with the colouring of the under side of its wings.* Of butterflies belonging to the Tropical American genus *Siderone*, Mr. Dent states:—"They always rest with wings folded over their bodies on branchlets, the markings and colouring of the under side of the wings resembling exactly dry brown or yellow leaves."† Mr. Cornish has written:—"Many of the small blue British butterflies have greyish spotted backs to their wings. At night they fly regularly to sheltered corners on the chalk downs where they live, alight head downwards on the tops of the grasses which there flourish, and, closing and lowering their wings as far as possible, look exactly like a seed-head on the grasses."‡ Mr. Carrington noticed for several evenings that a large White Cabbage Butterfly (*Pieris brassicæ*) searched out a few "sportive" whitish or cream-coloured leaves of a variety of ivy, and roosted upon one for the night.§ Mr. Trimen has observed the Satyrid butterfly *Melanitis leda*, which "rests among dead leaves on the ground in shady places, and is then indistinguishable from them"; and a parallel case, and a similar effect, is produced by the female *Eronia leda*, which settles on the faded bright yellow leaves of the *Erythrina* tree.|| Our well-known Orange-tip Butterfly (*Euchloë cardamines*), as observed by Mr. T. W. Wood towards evening or in cloudy weather, may be found at rest on the tops of grass or flowers, but more particularly on *Anthriscus sylvestris*, and almost always near that plant; the chequered white and green alone visible when the insect is at rest assimilates with the white flowers of the *Anthriscus* as seen against the green background.¶ Attention has recently been called to what appears to

* 'S. African Butterflies,' vol. i. p. 34. † 'A Year in Brazil,' p. 384.

‡ 'Animals of To-day,' p. 197. § 'Sci. Gossip,' new ser. vol. i. p. 10.

|| Pres. Addr. to S. Afr. Philosoph. Soc. 1884, p. lxxiv.

¶ 'Proc. Ent. Soc. Lond.' 3rd ser. vol. i. p. 147 (1863).—Mr. Wood states that "it was remarkable also that the butterfly did not appear to be partial to the *Anthriscus*, except as a secure resting place, but preferred to hover over and suck the juices of the wild geranium and other flowers."



be more or less active mimicry in two small British moths. *Penthina gentianana*, in its larval condition, feeds on the pith of the receptacle in teasel-heads, seed-heads of *Dipsacus sylvestris*; while another moth (*Eupæcilia roseana*) feeds on the seeds themselves. "The habit of *P. gentianana* on its emergence is to sit with head buried between the spinous scales of the receptacle, and with the posterior portion of its wings projecting a little beyond them. Roughly divided (as the insect is into a light upper and a dark lower part), its resemblance when in this position to a bird's excrement is very noticeable. If a number of teasel-heads be examined, it will be found that in some instances the inner part of the seeds—i.e. that part which is in contact with adjacent seeds—assumes a bright pink colour. Now, *E. roseana* has a very frequent habit of sitting lengthways along the spines of the scales above referred to, and here again the resemblance of the insect, with its colouring of rosy pink shading into yellow, to a partly displaced seed is worthy of notice."* One of the strongest illustrations of protective mimicry by a butterfly, and one of the most widely known—for who has not read Wallace's 'Malay Archipelago'?—is afforded by leaf-butterflies of the genus *Kallima*. But, as Mr. Badenoch has well enquired, "Of what avail would be the disguise were the insect prone to settle upon a flower, or green leaf, or other inappropriate surface?"† The partiality of this insect for settling on dry and withered leaves appears a true instance of active mimicry. The idea of some conscious volition in the protective habits of this butterfly is supported by remarks made by the Indian naturalist who writes under the name of "Eha":—"They see a little better in front of them, and I have noticed that the leaf-butterfly always alights head downwards, so as to face anything coming up the tree, which is much the most likely direction of assault from a Lizard. (In pictures generally, and in the show-case at the British Museum (Nat. Hist.), the butterfly is turned the opposite way, facing upwards, which is no doubt more appropriate to its character as a leaf; but that is a detail rather above the intelligence of a Lizard: at any rate, I never saw a *Kallima* sit in that position.)"‡

* H. F. Fryer, 'Ent. Month. Mag.' 2nd ser. vol. x. p. 6.

† 'Romance of the Insect World,' p. 217.

‡ 'Natural Science,' vol. ix. p. 299.—This is in direct contradiction to

The well-known Tropical American butterflies belonging to the genus *Ageronia*, which flatten their similarly coloured wings on the lichen-covered trunks, are also described as to "invariably rest head downwards."* Mr. Geo. Windsor Earl relates that at Sourabaya he saw Lizards attack large moths, but they were not always successful, "unless they could manage to seize the head, when, after a struggle of a few minutes, the little reptile would bear away his prey to devour at his leisure."† Weismann seems more or less of this opinion also, for he observes:—"These markings are composed of two parts, the upper of which is on the fore wings, while the lower one is on the hind wings. The butterfly when at rest must therefore keep the wings in such a position that the two parts of each marking exactly correspond, for otherwise the character would be valueless; and, as a matter of fact, the wings are held in the approximate position, although the butterfly is, of course, unconscious of what it is doing. Hence a mechanism must exist in the insect's brain which compels it to assume this attitude, and it is clear that the mechanism cannot have been developed before the peculiar manner of holding the wings became advantageous to the butterfly, viz. before the similarity to a leaf had made its first appearance."‡ We should opine, however, that the *Kallima* is exercising some volition in seeking the environment of the withered leaves with which the under surface of its wings approximate, an action we have seen pursued by other butterflies with reference to different surroundings, and that the exact corresponding position of the wings is hereditary, and perhaps now describable as unconscious cerebration, or reflex action. Animals do not all use the same means for protection; the method may be different, but the

the description of the habits of another species of the genus as given by Wallace in his 'Malay Archipelago.'

* H. C. Dent, 'A Year in Brazil,' p. 384.

† 'The Eastern Seas,' p. 53.

‡ 'Essays upon Heredity,' &c., Eng. transl., vol. i. p. 287. — Weismann adds that "even this protective resemblance to or mimicry of a leaf is not perfect, for out of sixteen specimens in the collections at Amsterdam and Leyden which he examined, he could not find a single one which had more than two lateral veins on one side of the midrib of the supposed leaf, or more than three upon the other side; while about six or seven veins should have been present on each side" (*ibid.* p. 315).

purpose is similar. Thus Partridges "roost close to the ground, and sleep with their heads tucked close together. A covey in this position represents little more than a mass of feathers. They always spend their nights in the open, for protective reasons. Birds which do not perch would soon be extinct as a species were they to seek the protection of woods and hedge-bottoms by night. Such ground generally affords cover to vermin—Weasels, Polecats, and Stoats." *

An active or aggressive mimicry is probably the explanation of the observation recorded by Mr. Woodford, made on Peel Island, Moreton Bay, where in the yellow-and-white blooms of different shrubs he found Spiders which were practically concealed by their assimilative colouration to these flowers. They were seen to attack the Bees which visited the bloom.† M. E. Heckel, of Marseilles, has described an interesting case, which may be frequently seen in the South of France. The Spider, *Thomisus onustus*, is often found in the flowers of *Convolvulus arvensis*, where it hides itself for the purpose of snaring two Diptera, *Nomioides minutissimus* and *Melithreptus origani*, on which it feeds. *Convolvulus* is abundant, and three principal colour variations are met with—there is a white form, a pink one with deep pink spots, and a light pink form with a slight greenishness on the external wall of the corolla. Each of these forms is particularly visited by one of three varieties of *Thomisus*. The variety which visits the greenish form has a green hue, and keeps on the greener part of the corolla; that which lives in the white form is white, with a faint blue cross on the abdomen, and some blue at the end of the legs; the variety which lives in the pink form is pink itself on the prominent parts of the abdomen and legs. The colour, however, is of an assimilative nature, as M. Heckel found that when the pink, white, green, and yellow varieties of the Spider are confined together in a box they all become nearly white.‡

That undoubted examples of *active* mimicry are to be found among the Arthropoda will occur to the mind of every naturalist at the mention of "Trap-door Spiders." It is unnecessary to

* J. Watson, 'Poachers and Poaching,' p. 9.

† 'A Naturalist among the Head-Hunters,' p. 70, note.

‡ 'Nature,' vol. xlv. p. 451.

quote here all the observations made by competent and veracious authorities as to the beautiful adaptations effected by these Spiders, by which the lid or door of their burrows is made to perfectly assimilate with the surrounding surface. Gillies, describing the habits of a New Zealand species, writes :—"The evidences of thought, ingenuity, and reason are displayed in the selection of the particular materials used in special places ; in the calculation of the probabilities of certain contingencies happening ; and in the apparently careless arrangement of both living and dead matter, so as to make what is in reality the *highest art* appear to be the result of natural and ordinary circumstances." In some cases there is "a plant of green grass . . . planted artificially, and growing on the lid." In other cases "you will find clay on the outside of the lid, plastered and smooth, or possibly with an *imitation crack*, introduced apparently at random." In others, again, "the skilful artist brings to his aid all the taste and knowledge of the practical gardener—selects plants suited for his purpose, brings them from a distance, and actually transplants them to the top of his trap-door with astonishingly natural variety and arrangement"; or "you will find mosses of various hues and colours growing green, and sometimes brown and dead, upon the lid"; or sometimes "this tiny pasture is brilliantly ornamented with parti-coloured patches of lichens," or "sprigs of lycopods, ferns or heaths, veronicas, and white-berry plants are introduced to correspond with the bolder herbage around"; or, "if the common white tussock is the prevailing vegetation in the locality, . . . the dead bits (of that kind) of grass are woven adroitly into the trap-door or round its mouth, so as to deceive the most practised eye," &c.* Moggridge found a nest in a plant which had been brought to him which was quite covered on the surface with moss, and the moss grew on the surface of the door itself, and looked exactly like that growing all round.† Livingstone describes a nest of which "the outside looks exactly like the surrounding surface of the ground, so that when the door is shut it is impossible to find the nest. The hole can therefore only be seen when the inhabitant has gone out and

* Quoted by W. Lauder Lindsay, 'Mind in the Lower Animals,' vol. i. p. 528.

† 'Harvesting Ants and Trap-door Spiders,' p. 97.

has left the door open behind it.”* It may be contended that this shows only mimicry in the habitation, and not in the appearance of the animal itself; or, again, that “aggressive” rather than “active” should be the qualitative term applied to this mimicry; but we can refer to instances where animals disguise their own bodies in a similar manner, and with a like intelligence, to these Spiders. The little Æsop’s Prawns (*Hippolyte (virbius) varians*, Leach, and *H. fascigera*, Gosse) may perhaps be cited as practisers of active mimicry. Prof. Herdman, in 1893, described four variations of *H. varians*, each agreeing in hue with the colour of its special habitat,† and was inclined to accept the fourth possibility of explanation which he suggested; viz. “The young may be very variable in tint, and then, by the action of natural selection, such as do not agree in hue with the surroundings will be eliminated.” Mr. James Hornell, at the Jersey Biological Station, has made a further series of experiments with these species, and has accepted the third postulate of Prof. Herdman, viz. the “adaptability may be retained throughout the rest of their lives, and the adults may change hue upon change of environment.” Mr. Hornell found that a pale olive-brown *H. varians* taken from amid similarly coloured seaweed became of a vivid green within an hour when placed with *Enteromorpha*, and the same specimen changed to a pinkish red within three hours when placed amid *Delesseria*. Again, red-coloured specimens of the same species from amongst tufts of red weeds changed to green during a single night when placed with *Enteromorpha*, or with *Cladophora*, and back again to red within four hours when placed once more amid red weed. This change of hue took place as rapidly in the dark as in the light. The weeds affected by the smooth-skinned *H. varians*, in the great majority of cases, are smooth in surface, and not overgrown with foreign matter. “In marked contrast, the body of *H. fascigera* is ornamented with tufts of brush-like hairs, and if a spray of the coarse *Corallina*, where this species makes its home, is examined, the stems are found covered with a multitude of abodes of tiny “messmates,” porcelain-like coils of the little tube-worm *Spirobis*, dull-looking cylinders tenanted by that lovely miniature Sabellid,

* ‘Pop. Account Travels in S. Africa,’ p. 221.

† ‘Sixth Annual Report of the Liverpool Marine Biology Committee.’

Othonia gracilis, and crusting colonies of *Bryozoa* protruding ever and anon circlets of hair-like tentacles." Hence, when the hairy *H. fascigera* is at rest on such a weed, the mimetic adaptation is greatly accentuated.* Thus also the connection of the small Short-tailed Crab (*Nautilograpsus minutus*), which swarms on the Gulf-weed, and assimilates in colour thereto. Sir John Murray, during the voyage of the 'Challenger,' studied the habits of these Crabs. He observed "that, although every floating thing upon the surface is covered with them, they are rarely met with swimming free, and that whenever they are dislodged and removed a little way from their resting place they immediately make the most vigorous efforts to regain it."† The Common Shrimp (*Crangon vulgaris*), when suspecting danger, "sinks upon the sand, and, setting his swimming-feet rapidly to work, they 'kick up such a dust' in the water that he is hidden in a cloud of fine sand, which as quickly settles down and partially buries him—sufficiently so with his sandy hue to effectually hide him."‡ Mr. W. A. Lloyd has described a somewhat similar habit of the Echinus or Sea-urchin. "Its chief delight, when in an aquarium, appears to be to cover itself with pebbles, which it picks up with its spines. At first I imagined that the little stones had fallen by mistake, and, wishing to do all in my power to render my captive happy, I removed the pebbles with a brush; but the Sea-urchin evidently did not appreciate my would-be kindness, for in a short space of time he had again covered himself with pebbles; and so completely was he hidden beneath them, that if he had not crawled up the side of the aquarium with his load I should have had some difficulty in discovering his whereabouts."§ Some species of Crabs, such as *Maja verrucosa*, *Pisa tetradon* and *P. armata*, *Inachus scorpioides*, and *Stenorhynchus longirostris*, cut off bits of Wracks, *Florideæ*, *Ulvæ*, &c., with their claws, and place them on the top of their carapaces, securing them on peculiar spiky or hooked hairs. The fragments grow firmly to the Crabs' chitinous coats, and, far from being harmful to the animals, are, on the

* 'The Journal of Marine Zoology and Microscopy,' vol. ii. pp. 101-103.

† Cf. Sir C. Wyville Thomson, 'The Voy. of the Challenger.'—"The Atlantic," vol. ii. p. 11.

‡ Edw. Step, 'By the Deep Sea,' p. 168.

§ 'Life beneath the Waves,' pp. 83-4.

contrary, an important means of protection. The Crabs in question escape pursuit in consequence of this disguise, and it is to be observed that each species chooses the very material which makes it most unrecognizable to plant upon the exterior of its body; those species which live chiefly in regions where *Cystosiras* are indigenous deck themselves in *Cystosiras*, whilst those which inhabit the same places as *Ulvæ* carry *Ulvæ* on their backs.* This also serves as aggressive mimicry; for, as Mr. Woodward writes, "thus disguised like Indians stalking game, they can readily approach their more active prey."† Mr. Bateson observed this active mimicry at Plymouth, and describes how a Crab seizes a piece of weed, tears off a fragment, chews the end in its mouth, and then rubs it firmly on its head and legs until it is caught by the curved hairs and fixed. "The whole proceeding is most human and purposeful. Many substances, as Hydroids, Sponges, Polyzoa, and weeds of many kinds and colours, are thus used; but these various substances are nearly always symmetrically placed in corresponding parts of the body, and particularly long plume-like pieces are fixed on the head."‡ Dr. Willey records a similar observation which he made on the faces of rocks near Tjibodas (Java). "I found a quantity of small caterpillars living on the powdery Alga which makes greenish-white patches on the rocks. The caterpillars had so completely covered themselves with the Alga as to be only discernible by their movements on close inspection, and their disguise must effectually protect them from foes."§ "Equally marvellous, too, is the case of many kinds of caterpillars which spin their cocoons on the bark of trees, and cover the structures wherein they are subsequently to undergo transformation into the chrysalis state with lichens and fragments of bark, that their temporary resting place may not be noticed by insectivorous birds."|| When the caterpillar of the Indian butterfly, *Limenitis procris*, "comes out of the egg, it betakes itself at once to the very point of a tender leaf, and eats down steadily on both sides of the midrib, which

* Kerner and Oliver, 'Nat. Hist. Plants,' vol. i. p. 77.

† 'Cassell's Nat. Hist.' vol. vi. p. 197.

‡ Cf. J. A. Thomson, 'Study of Animal Life,' 2nd edit. p. 62.

§ 'Natural Science,' vol. vi. p. 407.

|| Kerner and Oliver, 'Nat. Hist. Plants,' vol. ii. p. 159.

stands out bare and dry. As the little thing advances it cuts up much more of the leaf than it eats, and these crumbs, with other refuse, are gradually accumulated, and loosely bound together with silk till they form a breastwork across the whole breadth of the leaf. Behind this rampart of refuse, of which its brown and ragged form seems to be a portion, the little architect lives, pushing the work back from day to day as it eats on."* Kirby and Spence pointed out many instances of the same active and intelligent mimicry. "Of this description is a little water-beetle (*Elophorus aquaticus*), which is always found covered with mud, and so when feeding at the bottom of a pool or pond can scarcely be distinguished by the predaceous aquatic insects from the soil on which it rests. Another very minute insect of the same order (*Limnius æneus*), that is found in rivulets under stones and the like, sometimes conceals its elytra with a thick coating of sand that becomes nearly as hard as stone." "A species of a minute coleopterous genus (*Georyssus areniferus*), which lives in wet spots where the Toad-rush (*Juncus bufonius*) grows, covers itself with sand; and another nearly related to it (*Chætophorus cretiferus*, K.), which frequents chalk, whitens itself all over with that substance. As this animal when clean is very black, were it not for this manœuvre it would be too conspicuous upon its white territory to have any chance of escape from the birds and its other assailants."†

Many examples of active mimicry are exhibited by our British moths, as may be learned by consulting the pages of Mr. Barrett's excellent work on the 'Lepidoptera of the British Islands.' Thus *Eriogaster lanestris* is an instance, for "even when sitting on a hawthorn spray it so accurately mimics a dead leaf twisted round the twig that it becomes almost impossible of recognition."‡ *Cerura furcula* sits in the daytime "on the trunk, or more usually on a branch, of one of its food-trees, its outstretched downy legs and grey markings giving it a most deceptive likeness to an entangled downy feather, or even a more close resemblance to a ripe sallow catkin from which the downy seeds are bursting."§

* Eha, 'A Naturalist on the Prowl,' pp. 127-8.

† 'Introd. Entomology,' 7th edit. pp. 424-5.

‡ 'The Lepidoptera of the British Islands,' vol. iii. p. 12.

§ *Ibid.* p. 89.

Its larva feeds on sallow and willow. *Petasia cassinea* is said in the daytime "to sit upon old posts and railings, and is very hard to see, from its close resemblance to a bit of decayed wood, or to the greyish-brown lichens. Its extended and tufted feet, and rough scales at the edge of the fore wings, all help to complete the deception."* *Cymatophora duplaris* exhibits a purpose in active mimicry of the highest description, both as a caterpillar and a perfect moth. The larva during the day "conceals itself in a habitation formed of green leaves united by silken threads upon the tree. At night it comes forth to feed."† The moth sits in the daytime on the branches of trees. "When shaken out it falls straight to the ground, and lies among the dead leaves."‡ *Arsilonche venosa*, in colour and markings, like those of so many other fen-frequenting species, is accurately suited to its habit of hiding in the daytime among the dead leaves of reed, sedge, and marsh-grasses.§ *Agrotis ashworthii* "sits in the daytime on limestone rocks, or hides among loose stones. In appearance it closely resembles the blue limestone, and it has the sagacity to hide itself in chinks and crevices, where this resemblance greatly assists in its concealment."|| All these examples scarcely bear out an automatic or semi-automatic action; we seem to see among these lowly organised insects—referring, of course, to sense organs—a capacity and endeavour to use their environmental resemblances to the best advantage. There may be much heredity in such an aptitude, but the intelligent concealment would not be questioned if practised by the higher animals.

The instances of active mimicry just given almost appertain to decorative art, and in fact represent the impostor who with borrowed plumes flaunts in the open. We now resume the series of more modest simulation, in which advantage is taken of similarly coloured objects by which concealment may be effected. These may nearly be said to reflect the methods of the impostors who attach themselves to majorities, winning causes, and crowds, where they are submerged in resemblances, and, undetected, reap the corresponding advantage. The Australian genus of Sea-

* 'The Lepidoptera of the British Islands,' vol. iii. p. 157.

† *Ibid.* p. 195.

‡ *Ibid.* p. 196.

§ *Ibid.* p. 277.

|| *Ibid.* p. 383.

horses (*Phyllopteryx* sp.) "closely resemble the colour of seaweeds to which they attach themselves, while the filamentous appendages of their spines appear as if they were actually a part of the vegetable growth."* The Dragonfly larva "trusts chiefly to its sombre colouration and its motionless attitude. The larva clinging to a stem in the shady recesses of water-weeds is not easily distinguished, and the absence of movement removes the chief risk of discovery."† Many caterpillars resort to the bark of trees, with which their colour and often notched, knotted, or spotted bodies closely assimilate. That this is a form of active mimicry may be gleaned from the remarks of a British entomologist:—"A number of these mimics of the insect world never venture to feed by day, but take in their quantum of provision during the dark hours, and practise their deceptions during the day."‡ Active mimicry may also explain resemblances which Weismann is very emphatic in dehying as due to "external influences." "If a caterpillar, which hides itself by day in the crevices of the bark, possesses the same colour as the latter, whilst other caterpillars which rest on leaves are of a green colour, these facts cannot be explained as the result of the direct influence of the bark and leaves. And it would be even less possible to explain upon the same principle all the details of marking and colour by which these animals gain still further protection. If the upper side of the upper wings of certain moths is grey like the stone on which they rest by day, while in butterflies the under side of both wings which are exposed during rest exhibits analogous protective colours, these facts cannot be due to the direct influence of the surroundings which are resembled; but, if they have arisen in any natural manner, they must have been indirectly produced by the surroundings."§ These last remarks appear to be obscure. Surely, to make the proposition clear, some explanation should have been given as to what is meant to be differentiated between "cannot be due to the direct influence of the surroundings," and "must have been indirectly produced by the surroundings." And therefore, per-

* 'Royal Nat. Hist.' vol. v. p. 426.

† L. C. Miall, 'Nat. Hist. Aquatic Insects,' p. 332.

‡ W. Furneaux, 'Butterflies and Moths (British),' pp. 31-2.

§ 'Lectures on Heredity,' &c., 2nd edit., Eng. transl., vol. i. p. 409.

haps Prof. Weismann is scarcely justified in observing, "one may reasonably complain when compelled to repeat again and again these elements of knowledge and of thought upon the causes of transformation."* A recent writer would apparently regard the *Phasmidæ* as examples of active mimicry. He is reported as saying:—"Amongst true instincts he would class such acts of protective mimicry as those performed by the *Phasmidæ*, although their alleged practice of shamming death might possibly be constitutional lethargy, which had misled observers."† We have already recorded Mr. Belt's observation in Nicaragua as to the behaviour of a leaf-like Locust when surrounded by a host of predaceous Ants. A somewhat similar fact has been narrated by "Eha":—"I was sitting high up in a tree, rifle in hand, waiting for a Tiger, when my attention was caught by one of these Crickets (exactly resembling a small patch of grey lichen) scurrying round the trunk of a neighbouring tree, with a Lizard in full pursuit. Just as the Lizard came up with it the Cricket, falling in with a slight depression in the bark, stopped dead, and flattened itself out, and the Lizard was utterly confounded. There it stood, looking ludicrously puzzled at the mysterious disappearance of its prey, which was just under its

* 'Lectures on Heredity,' &c., 2nd edit., Eng. transl., vol. i. p. 410.

† C. W. Purnell, 'Phil. Instit. Canterbury, New Zealand.'—Cf. abstract in 'Nature,' vol. lii. p. 384.—The "feigning of death" among some animals, especially reptiles, may be taken as a psychological parallel to active mimicry. Nevertheless, it has been argued that with insects this process is a "purely reflex phenomenon," rather than an act of volition. Mr. Latter experimented with the Currant Moth (*Abraxas grossulariata*), whose powers of "shamming" are so familiar. When seized by one wing it at once feigned death, but so it also did after being decapitated, and this action was continued in response to the same stimulus during the two days that elapsed before its death ('Nature,' vol. lii. p. 543). Like Toads, Tree-frogs do not appear to touch the insects on which they prey until these begin to move ('Roy. Nat. Hist.' vol. v. p. 281). The feigning of death apparently has a protective purpose among the inferior animals. Prince Kropotkin, on the authority of Nagel, states:—"The water-beetle (*Dytiscus*) does not perceive the presence of animals which it preys upon within a distance of a few millimetres, so long as they remain motionless" ('Nineteenth Century,' vol. xl. p. 253). Mr. Oxley Grabham records an instance of a Grasshopper Warbler (*Locustella naevia*) feigning death when touched on the nest, allowing herself to be handled as if dead—"a quivering of the eyelid was all that showed she was shamming" ('Zoologist,' 4th ser. vol. ii. p. 351).

nose.”* The Horned Frog (*Ceratobatrachus guentheri*) of the Solomon Islands is described by Mr. Guppy to so closely imitate its surroundings, both in colour and pattern, that on one occasion he captured a specimen by accidentally placing his hand upon it when clasping a tree.† This species is so variable in colouration and in the integuments, that Mr. Boulenger has remarked, “Out of the twenty specimens before me no two are perfectly alike.”‡ This is probably a case of what is here considered active mimicry.

Birds exhibit many illustrations of active mimicry. A recent writer in ‘The Zoologist’ called attention to some peculiar “attitudes of a Little Bittern observed in captivity.” The real meaning of the attitudes of this bird (*Botaurus minutus*) seem only to have been understood by the then editor, Mr. Harting, who thus comments on the same:—“The inference to be drawn from these remarks is that the curious attitudes adopted by this bird, on finding itself observed, are assumed in the exercise of what may be termed the instinct of self-preservation, and in a state of nature must tend materially to favour its concealment. Whether it be standing in or near a reed-bed, erect, with neck preternaturally elongated and beak pointed upwards, or crouching against a riverside tree-stump, the attitude is calculated to deceive the eyes of all but the keenest observers, especially since the colour of the bird’s plumage harmonizes in a remarkable degree with that of the natural surroundings.”§ Mr. Hudson has made a similar remark concerning the Common Bittern (*Botaurus stellaris*). “His buff and yellow and chestnut colour, mottled and barred and pencilled with black and brown, gives him a strange tigrine or cat-like appearance; it is a colouring well suited to his surroundings, where yellow and brown dead vegetation is mixed with the green, and the stems and loose leaves of the reeds throw numberless spots and bars of shade beneath. Secure in its imitative colouring, the Bittern remains motionless in its place until almost trodden upon.”|| A very similar pro-

* ‘Natural Science,’ vol. ix. p. 299. † ‘The Solomon Islands,’ p. 317.

‡ *Ibid.* p. 316.

§ ‘Zoologist,’ 3rd ser. vol. xviii. p. 456.

|| ‘British Birds,’ p. 225.—The same writer has given a vivid description of a similar habit of an Argentine Heron (*Ardetta involucris*), and refers to “a marvellous instinct that makes its peculiar conformation and imitative colour far more advantageous than they could be of themselves” (P. Z. S. 1875, p. 629-31).

ceeding, as far as intention is exhibited, though appertaining more to what is understood by "aggressive mimicry," is to be found in the account of the habits of the Cassowary (*Casuarus bennetti*), given by Mr. Wilfred Powell as observed in the island of New Britain:—"I saw a Morroop (Cassowary) come down to the water's edge, and stand for some minutes, apparently watching the water carefully; it then stepped into the river, where the water was about three feet deep, and, partially squatting down, spread its wings out, submerging them, the feathers being spread and ruffled. The bird remained perfectly motionless; I also noticed that the eyes were closed, as if asleep. It remained in this position for fully a quarter of an hour, when, suddenly closing its wings and straightening its feathers, it stepped out on the bank, where, shaking itself several times, a quantity of small fishes fell from under the wings and from amidst the feathers, which were immediately picked up and swallowed. The fishes had evidently mistaken the feathers for a description of weed that grows in the water along the banks of the rivers in this island, and very much resembles the feathers of the Cassowary, and in which the smaller fish hide to avoid the larger ones that prey on them."* The Ruffed or Birch Partridge in Canada has been described by Dr. Leith Adams as flying to a tree to escape danger, where "their statue-like posture, with neck outstretched, and their motionless position on the moss-clad spruce-bough, render it extremely difficult to recognize them." So close is this active mimicry carried out that it is sometimes only by the barking of Dogs that the sportsman is aware of the close proximity of the birds. In the words of Dr. Adams, describing an actual experience, "In vain we looked, for no Partridge was to be seen; still the Dog barked, and began to bite and tear off the bark, when at length three birds were discovered standing motionless on the moss-covered boughs, and within a few yards of us."† Even more forcibly Mr. Anthony, of San Diego, California, describes the active mimicry of the "Long-eared Owls," who can assume a "rigid, stick-like position" to the surrounding shrubs and branches. "To escape notice—so great is their faith

* 'Wanderings in a Wild Country,' pp. 271-2; and 'Proc. Zool. Soc.' June 15th, 1880.

† 'Field and Forest Rambles,' pp. 175 and 176.

in the protection afforded them by this resemblance, when several are together, as is often the case in winter—one or more may be shot without the rest showing so much as by the movement of a feather that they are disturbed.” On one occasion a friend with whom he was hunting came upon five of these Owls sitting in a row on a limb of a giant cottonwood. “Beginning at one end of the line, he shot them all, one after another, his last shot starting a sixth, which he had not seen, from a perch in the same tree.” When Mr. Anthony arrived upon the scene they began looking for the escaped Owl, but failed to discover it. “As we were leaving, however, my eyes chanced to fall upon what at first appeared to be an abnormal growth on the trunk of a small sapling near us, but which, upon a second glance, proved to be a little Screech-Owl. With its back against the trunk of a tree it was drawn up to its fullest height, all its feathers drawn tight against its body, its ear-tufts erect. It looked to be twice its normal length, and so closely did it resemble the grey bark and branches that, unprotected as it was by leaves or twigs in the strong glare of a bright winter’s day, its discovery was purely accidental. Our tracks in the snow proved that we had several times passed within ten feet of the bird, and it was quite evident that it was aware of our presence; for, while it made not the slightest movement, it watched us constantly through its half-closed lids, trusting no doubt to escape detection, but ready to fly if the occasion required.” *

Geese and Ducks seem to mimic snakes. In the opinion of Mr. Louis Robinson:—“It seems very probable that the hiss of the Goose, when it desires to show hostility, is founded upon the hiss of the serpent. Many Ducks also, when nesting, will thrust out their necks and hiss when an intruder approaches, and a Muscovy drake is almost as ready to adopt this method of intimidation as a gander. It is found that nearly all long-necked birds which nest among reeds and bushes show a similar habit. One can easily understand that among thick grass or reeds, where only the head and neck of a nesting Duck are visible, the forward dart and hiss might often be sufficient to deter a cautious enemy from making an attack.” †

* ‘Science,’ vol. xxiii. p. 64.—Capt. Bendire has made a similar observation on this species (*Asio americanus*).

† ‘Wild Traits in Tame Animals,’ pp. 281-2.

I have related my own experience in the Transvaal with *Francolinus levaillantii*, a single member of which from a covey I had disturbed squatted in a small hole in the path about eighty yards in front of me, and, depressing its back level with the earth, exhibited a good instance of the protection obtained by assimilative colouration.* A young Merganser deceived the Duke of Argyll and a party of his visitors at Inverary by simply remaining perfectly still on ground on which it was inconspicuous by reason of the protective resemblance or mimicry of its colour.† Mr. R. Kearton states:—"I have on more than one occasion seen a baby Peewit wandering about with half of its prison-house still attached to its downy rump, and if a Hawk or other bird of prey should happen to appear overhead they instinctively clap flat upon the ground, and remain motionless as stones until the danger has passed."‡ The Dabchick, on quitting the nest, according to Mr. Hudson, "invariably draws a coverlet of wet weeds over the eggs; the nest in appearance is then nothing but a bunch of dead vegetable rubbish floating in the water."§ Young Emus are very different in colour from the old birds, and bear a delicate design of a pretty dark grey with numerous stripes on their back and sides. Mr. Semon relates:—"Young Emus are often pursued by Eagles and Hawks so frequent in Australia. When (so my blacks told me) the young Emus see a bird of prey soaring above them they quickly lie down flat upon the ground. A body as big as theirs would surely be much more conspicuous, set off as it is by grass, if it were *evenly* though ever so modestly coloured, than if its colouring be varied by stripes and spots. I myself have had occasion to notice how difficult it is to discover an Emu in the grass if it nestles to the ground."|| Gilbert White remarks on the Stone Curlew (*Ædicnemus crepitans*):—"The young run

* 'A Naturalist in the Transvaal,' p. 75.—Subsequently I observed how this action could become habitual without a suitable environment. I flushed a pair of *Francolinus subtorquatus*, one of which squatted in the same manner, but, by force of circumstances, among the short, black, and charred remains of a grass fire. Here its colour stood out in bold relief, and I easily bagged it.

† Cf. W. Lauder-Lindsay, 'Mind in the Lower Animals,' vol. i. p. 526.

‡ 'With Nature and a Camera,' p. 210.

§ 'Birds in London,' pp. 99-100.

|| 'In the Australian Bush,' pp. 145-6.

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immediately from the egg like Partridges, &c., and are withdrawn to some flinty field by the dam, where they skulk among the stones, which are their best security, for their feathers are so exactly of the colour of our grey-spotted flints, that the most exact observer, unless he catches the eye of the young bird, may be eluded."* The same observer records an illustration of active mimicry in a Willow-Wren:—"This bird a friend and myself had observed as she sat in her nest, but were particularly careful not to disturb her, though we saw she eyed us with some degree of jealousy. Some days after, as we passed that way, we were desirous of remarking how this brood went on; but no nest could be found, till I happened to take up a large bundle of long green moss, as it were carelessly thrown over the nest, in order to dodge the eye of any impertinent intruder."†

Active mimicry, rather than natural selection *per se*, appears very largely to account for the assimilative colouration of birds' eggs to their nests or environment. Without recapitulating all the evidence which can be readily obtained from so many sources—either by observation, or reference to much illustrated literature—we may safely conclude, with Mr. Wallace, that on the whole, "while white eggs are conspicuous, and therefore especially liable to attack by egg-eating animals, they are concealed from observation in many and various ways."‡ This is a very important consideration before we proceed farther. We find a great number of white or prominent eggs, apparently unaffected by "natural selection," but preserved by intelligent concealment, which is only a form or phase of what we have noted before, and to what will be referred to again on this very matter of birds' eggs, as active mimicry. If the process of natural selection was to be applied, according to a very frequent method, as *universal*, then birds arising from these white and prominent eggs would seem in course of time to be doomed to destruction. But we find nothing of the kind. Natural selection is here replaced by the evolution of intelligence or active mimicry. True, it may be

* 'Nat. Hist. Selborne,' Harting's edit. p. 55.—Grant Allen, in the introduction to his own edition of White, refers to this observation as "the germ of the theory of Protective Mimicry."

† *Ibid.* p. 175.

‡ 'Darwinism,' p. 214.

argued that birds laying white eggs would become extinct without they had gradually acquired the intelligent or automatic powers of concealment through a process of natural selection. But this is only begging the question. The colour of the egg has not altered under this severe stress, and we can see that many eggs are completely either adapted to their environment, or are so marked and coloured that the birds by choosing a proper environment, or, again, exercising active mimicry, can leave such in practical exposure. "Primarily the eggs of birds must have been white, from the inherent colour of the salts of lime and magnesia of the shell."* "As a rule, Sandwich Terns' eggs harmonize closely with their surroundings, and even the experienced field naturalist has to exercise a great deal of care to avoid treading upon a clutch when visiting a breeding station. A friend of mine told me a few years back that he had once visited a colony of these birds on an island where the natural breeding accommodation was so limited that many of them had conveyed patches of pebbles on to the grass, and laid their eggs thereon."† Take, for instance, our Nightjar or Goat-sucker. As Mr. Watson has remarked, "this night-flying bird, half-Owl, half-Swallow, rests during the day on bare bits of limestone on the fells. Its mottled plumage exactly corresponds with the grey of the stones, and its eggs, in colour like its plumage, are laid upon the bare ground without the slightest vestige of a nest, and again entirely resemble the stone."‡ Now take another good example from Mr. Wallace. The common Black Coot (*Fulica atra*) "only breeds in certain localities where a large water-weed (*Phragmites arundinacea*) abounds. The eggs of the Coot are stained and spotted with black on a yellowish-grey ground, and the dead leaves of the reed are of the same colour, and are stained black by small parasitic fungi of the *Uredo* family; and these leaves form the bed on which the eggs are laid. The eggs and the leaves agree so closely in colour and markings that it is a difficult thing to distinguish the eggs at any distance. It is to be noted that the Coot never covers up its eggs as its ally, the Moor-hen,

* James Newton Baskett, 'Papers presented to World's Congress on Ornithology,' Chicago, p. 95.

† Richard Kearton, 'With Nature and a Camera,' p. 254.

‡ 'Poachers and Poaching,' p. 136.

usually does.”* Mr. Wallace considers that these eggs “are coloured in a specially protective manner,” but it is equally open to argument, that as white eggs are concealed, and the mottled-grey egg of the Nightjar laid on the similarly coloured ground, so the concealing, or active mimicking, powers of the Coot suggest its placing its eggs among the leaves that so successfully hides them.

That birds may use a reasoning or cunning attribute in the deposition of their eggs where the colouration may prove of an assimilative character to the surrounding environment may be argued from the evidence which exists of their pursuing an equivalent mental process in the placing of their nests. Thus recently a writer has described “some curious experiences in birds’ nesting.” He found a Blackbird’s nest “situated in a depression in the ground, in just such a position as a Sky Lark’s might occupy.” A keeper who accompanied him had found several other Blackbirds’ nests in similar positions. Within a few hundred yards two Thrushes’ nests were also found on the ground, “the edge of the nests being level with the surface.” On enquiry it was stated “that the proprietor, having found that this wood was a nesting stronghold of these species, had made systematic raids on their nests in consequence of the havoc made by the birds on his fruit. I think this fact suggests why these birds had departed from their usual habit in their choice of nesting sites. Profiting from experience, they had selected safer positions.” The same writer records facts to prove that the Common Sandpiper “profits by experience, and occasionally varies its choice of nesting sites.” In 1886 these birds had their nests twice swept away from the river-banks by heavy floods. In the following year nests were found fully a hundred yards from the river. “From May, 1886 (the date of these floods), until 1889, the Sandpipers continued to nest at some distance from the river.”† The Samoan Tooth-billed Pigeon (*Didunculus strigirostris*), which formerly bred on or near the ground, and was so greatly reduced in numbers by Cats as to be threatened with extermination, eventually took to nesting and roosting in trees, and has since been gradually on the increase.”‡ We have not

* ‘Darwinism,’ p. 215.

† Dr. R. Williams, ‘The Zoologist,’ 3rd ser. vol. xx. pp. 372-3.

‡ F. A. Lucas, ‘Rept. Nation. Mus.’ Washington, 1891, p. 612.

yet reached the explanation of the colours of eggs; we have only by observation seen—under “natural selection,” if you will, or active mimicry—how avian subterfuge has in so many cases combated the pertinacious search of the persistent enemies to bird existence.

Sometimes this mimicry appears only as a survival, and when its character is no longer protective. “The bird which in the arctics long ago lined its nest with green moss or grey lichens may now floor it with flax in Dakota, or pad it with cotton in Texas; and yet in either deposit a solid green or mottled greyish egg in keeping with the colours of ‘the old house at home.’”^{*} Thus the eggs of the Wild Duck are placed among the green reeds, while those of the Lapwing are with equal confidence consigned to the ploughed field or upland. The Red Grouse can safely leave its speckled eggs among the heather; the Lesser Tern has little fear that its spotted egg will be noticed on the shingle, or the Ringed Plover that its egg will be readily distinguished from the sand on which it is laid. Take Mr. Seebohm’s ‘History of British Birds,’ with its beautiful illustrations of eggs, often so decisive in colour and markings, and then find the eggs in their natural surroundings, and one will then experience how “the whole creation groaneth,” or rather the intense beauties and harmonies that have arisen in Nature because she “is red in tooth and claw.”

Mammals contribute the same evidence, and the narratives of sportsmen and travellers afford many instances. According to Mr. Buxton, the Sardinian Mouflon (*Ovis musimon*) was one of the most difficult animals to approach with which he was acquainted. He observes, that “when they are alarmed, or ‘at gaze,’ they have a habit, or at least the rams have, of placing themselves in the middle of a bush of *Macquia*, or in the shadow which it casts. The ewes, who are naturally less conspicuous, do this in a less degree.”[†] The same authority describes a similar habit in the Barbary Sheep (*Ovis tragelaphus*), known by the name of “Aroui”: “They are constantly within sight and hearing of the Arabs and their Goats, and, having no means of escaping from their neighbourhood, have developed the art of hiding themselves to

^{*} James Newton Baskett, ‘Papers, World’s Congress on Ornithology,’ Chicago, p. 100.

[†] ‘Short Stalks,’ 2nd edit. (1893), p. 22.

an extraordinary degree, and their confidence in their own invisibility is unlimited. A practical illustration of this occurred to me one evening when I had sat in one place for twenty minutes carefully spying the surrounding country. My coign of vantage was a knoll which commanded a small shallow hollow, in which there was not a vestige of cover, except the few thin *thuja* bushes which looked as if they could not hide a Rat. It was not till I rose to shift my position that a female Aroui and two yearlings started from these bushes. They had been lying within sixty yards of me, and must have been fully conscious of my presence." * Le Vaillant writes: "If the Giraffe stands still, and you view it in front, the effect is very different. As the fore part of its body is much larger than the hind part, it completely conceals the latter; so that the animal resembles the standing trunk of a dead tree." † Mr. Baines, the African traveller, related to Frank Buckland that "the Giraffe seems to know that if he keeps perfectly quiet he will be mistaken for a tree; if he moves, his presence will become apparent to his enemy—man." ‡ Baines himself has recorded that a Giraffe he watched passing through the bush looked "for all the world, as he stopped to gaze, like the white stump of a dead tree, which anyone might have passed by without suspecting it of the power of motion." § Sir Samuel Baker bears the same witness: "It may be readily imagined that, owing to the great height of this animal, it can be distinguished from a distance, and does not require an elaborate search; nevertheless, it is exceedingly deceptive in appearance when found among its native forests. The red-barked *mimosa*, which is its favourite food, seldom grows higher than fourteen or fifteen feet. Many woods are almost entirely composed of these trees, upon the flat heads of which the Giraffe can feed when looking downwards. I have frequently been mistaken when remarking some particular dead tree-stem at a distance, that appeared like a decayed relic of the forest, until, upon nearer approach, I have been struck by the peculiar inclination of the trunk: suddenly it has started into movement and disappeared." || Gordon Cumming narrates

* 'Short Stalks,' 2nd edit. (1893), p. 136.

† 'New Travels into Int. Parts of Africa,' Eng. transl. vol. ii. pp. 278-9.

‡ 'Curiosities of Natural History,' pop. edit. 3rd ser. p. 232.

§ 'Explorations in S.W. Africa,' p. 387.

|| 'Wild Beasts and their Ways,' vol. ii. p. 151.

a similar experience:—"In the case of the Giraffe which is invariably met with among venerable forests, where innumerable blasted and weather-beaten trunks and stems occur, I have repeatedly been in doubt as to the presence of a troop, until I had recourse to my spyglass, and on referring to my savage attendants I have known even their optics to fail, at one time mistaking these dilapidated trunks for camelopards, and again confounding real camelopards with these aged veterans of the forest."* Mr. Vaughan Kirby says: "They stand perfectly still, not even swishing their tails like wildebeeste, and thus bringing about instant recognition; their mottled or dark colour, great height, and comparatively narrow bodies give them a striking resemblance to the many old vari-coloured relics of the forest, blasted by lightning or by bush-fires,"† Col. Pollok attributes the same habits to the Indian Elephant (*Elephas indicus*):—"If nature has not given intellect to these animals, it has given them an instinct next thing to it. One has only to hunt them in their wilds to learn how wonderfully Providence has taught them to choose the most favourable ground, whether for feeding or encamping, and to resort to jungles where their ponderous bodies so resemble rocks or the dark foliage that it is most difficult for the sportsman to distinguish them from surrounding objects."‡ Gordon Cumming relates a similar experience in South Africa with regard to *Elephas africanus*:—"The ashy colour of his hide so corresponds with the general appearance of the grey thorny jungles which he frequents throughout the day, that a person unaccustomed to hunting Elephants, standing on a commanding situation, might look down upon a herd and fail to detect their presence."§ An even stronger case, or more pronounced opinion, as to active mimicry is given by the American naturalist E. S. Thompson, and a Fox is the animal referred to:—"A fire had swept the middle of the pasture, leaving a broad belt of black; over this he skurried till he came to the unburnt yellow grass again, when he squatted down and was lost to view.

* 'Five Years' Hunting Adventures in S. Africa' (compl. pop. edit.), p. 132.

† 'In Haunts of Wild Game,' p. 337.

‡ 'Zoologist,' ser. iv. vol. ii. p. 167.

§ 'Five Years' Hunting Adventures in S. Africa' (compl. pop. edit.), p. 132.

He had been watching us all the time, and would not have moved had we kept to the road. The wonderful part of this is, not that he resembled the round stones and dry grass, but that he *knew he did*, and was ready to profit by it."* According to Livingstone's observations on a small Antelope named "Tianyáne":—"When the young one is too tender to run about without the dam, she puts one foot on the prominence about the seventh cervical vertebra, or withers; the instinct of the young enables it to understand that it is now required to kneel down, and to remain quite still till it hears the bleating of its dam. If you see an otherwise gregarious she-Antelope separated from the herd, and going along anywhere, you may be sure she has laid her little one to sleep in some cosy spot. The colour of the hair in the young is better adapted for assimilating it with the ground than that of the older animals, which do not need to be screened from the observation of birds of prey."† "Rabbits open their nesting burrows and suckle their young by night, closing them lightly with earth again when they leave them. I had a nest under close observation last spring, and was much interested to find that its owner scattered some old hay from a Sheep foddering-station close by, over the mould with which she filled the entrance to the burrow every time she left it, a procedure which materially lessened its chances of being discovered."‡ We can find another example in the East. In the South Mahratta country, according to Sir W. Elliot, it is a common belief of the peasants that in the open plains, where there is no cover or concealment, the Indian Wolves (*Canis pallipes*) scrape a hole in the earth, in which one of the pack lies down and remains hidden while the others drive the herd of Antelopes over him.§ The usual colour of these animals is a greyish fulvous, generally with a brownish tinge, so that active or aggressive mimicry is thus obtained. A similar explanation may be applied to the fact described by Capt. Scannon respecting the Californian Sea-lion (*Otaria gillespii*). This animal, when in pursuit of a Gull, "dives deeply, under water, and swims some distance from where

* 'Wild Animals I have Known,' p. 193.

† 'Mission. Travels and Researches in S. Africa,' p. 209.

‡ Richd. Kearton, 'With Nature and a Camera,' p. 180.

§ Cf. Lydekker, 'Roy. Nat. Hist.' vol. i. p. 500.

it disappeared, then, rising cautiously, it exposes the tip of its nose above the surface, at the same time giving it a rotary motion like that of a water-bug at play. The unwary bird on the wing, seeing the object near by, alights to catch it, while the Sea-lion at the same moment settles beneath the waves, and at one bound, with extended jaws, seizes its screaming prey, and instantly devours it.* Waterton has given a very similar suggestion. Beneath some agitated birds, and in the long grass, he saw what was apparently "a pale green Grasshopper," fluttering as though entangled in it. "Nothing more remained to be done but to wait in patience till it had settled, in order that you might run no risk of breaking its legs in attempting to lay hold of it while it was fluttering—it still kept fluttering, and, having quietly approached it, intending to make sure of it—behold, the head of a large Rattlesnake appeared in the grass close by. . . . What had been taken for a Grasshopper was, in fact, the elevated rattle of the snake."† Aflalo has remarked:—"The snake's power of fascinating birds is another moot point, on which Dr. Stradling has offered about the best suggestion, fully endorsed in Miss Hopley's charming book. His opinion is that the birds mistake the quivering tongue for a worm or insect, and that organ, considered by the ignorant to be endowed with 'stinging powers,' may consequently act as a bait to lure the incautious food within reach of the fatal jaws."‡ The Tree-Frog (*Hyla*) is of a light green colour when seated upon a light green leaf, but becomes dark brown when transferred to dark surroundings. "Hence this animal adapts itself to the colour of its environment, and thus gains protection from its enemies."§

* Cf. J. A. Allen, 'Hist. N. Amer. Pinnipeds,' pp. 301-2.

† 'Wanderings,' Wood's edit., pp. 166-7.

‡ 'Sketch of the Nat. Hist. Australia,' p. 161.

§ Weismann, 'Lectures on Heredity,' &c., Eng. transl., 2nd edit. vol. i. p. 309.—Weismann adds:—"That the chromatophores do not themselves react upon the direct stimulus of light was proved by Lister ('Phil. Trans.' vol. cxlviii. 1858, pp. 627-644), who showed that blind Frogs do not possess the power of altering their colour in correspondence with that of their environment."

NOTES AND QUERIES.

AVES.

Abundance of the Song-Thrush near Bradford.—The chief ornithological feature of the year in this district has been the immense number of Song-Thrushes (*Turdus musicus*) which have bred, in marked contrast to the years 1880 and 1881. As a rule, even in mild winters and late autumn, not many are to be seen here; but on the approach of spring, mostly in February, immigrants arrive, many of which withdraw sooner or later, according to the state of the weather, to breed probably in higher latitudes. This year, at the beginning of February, a larger number arrived than usual; most of the fields in the neighbourhood of woods were literally covered, and, contrary to what usually occurs, a large majority remained to breed. Having visited the woods almost daily during the breeding season, one could not fail to be struck with their abundance; indeed, it was a matter of common knowledge even to casual observers, and we hardly ever came into contact with any gamekeeper who did not repeatedly mention this fact. Another peculiarity was that a greater proportion of nests were built on the ground, and had larger clutches of eggs than in average years. If boisterous winds prevail in early spring a greater proportion of nests are built on or nearer the ground, or on more shielded places than would otherwise be the case; but, taking this factor alone into consideration, will not account for the exceptional phenomena of the present year. It is hardly conceivable that this large addition in numbers was bred here last year, and we cannot account for it except on the supposition that for some reason or other these birds remained here to breed, but under more favourable conditions would have bred in more northern latitudes. It would appear that some species of birds are more prolific in the north, and it is not at all unreasonable to suppose that many species of birds would be less strictly arboreal in their habits; but, be this as it may, the fact recorded requires explanation. It would be interesting to ascertain what are the habits of this species in more northern latitudes. Five eggs is the usual clutch in this district, but frequently four is the complement. Six is an exceptional number (one instance only this year has come to our knowledge), but even this latter number is sometimes exceeded. Whilst on this subject it may be said *en passant* how very different are the habits

of some species of birds even within a very limited area. An immense number of Missel-Thrushes' nests have come under our observation, but never one, in this district, has been built in any other situation than either in trees or bushes, very seldom comparatively in the latter. On the other hand, this species breeds not uncommonly in walls on the moors a little to the north of Bolton Woods, in Wharfedale, which are also well wooded—chiefly pine and larch with little or no underwood—and only some twenty miles in a bee-line north of this place. Both the Song- and Missel-Thrush are met with in much more varying numbers during the breeding season than the Blackbird, and in winter—even the severest winters—a much greater number of the latter remain compared with the number which obtains during the breeding season. — E. P. BUTTERFIELD (Wilsden, near Bradford).

Abnormal Nesting Sites of the Willow-Wren.—With reference to Dr. A. G. Butler's note on highly-placed nests of the Chiffchaff, I may mention that I have frequently found them situated as much as four feet from the ground, but never higher; a pair built for several years in succession in the top of a box-tree, a little over four feet, in the garden of a friend of mine. During the last spring and summer I have seen three nests of the Willow-Wren (*Phylloscopus trochilus*) in situations which, in the case of two of them, are unique in my experience. One was placed five feet from the ground in a spruce-fir, surrounded by a wild rose bush, built on a flat bough of the spruce, and entwined in the twigs of the rose. Of the other two, which were within a mile of each other, one was placed in an old Marsh-Titmouse's nesting-hole in the top of an old gate-post, 4 ft. 6 in. from the ground; and with regard to the other, a Robin built early in the year in a large hole in a wall five feet from the ground, and safely reared its young. Shortly after the nest was appropriated by a Willow-Wren, which domed over the old nest, and plentifully lined it with feathers. This bird also safely reared her young. I saw all nests, eggs, and old birds, and a friend took excellent photographs of the bird that built in the Robin's nest, feeding her young, in various positions. — OXLEY GRABHAM (Heworth, York).

"Chiffchaff building on the top of small Yew and Box Trees."—In this district Chiffchaffs rarely, if ever, build on the ground; I have found upwards of thirty nests in a season, but have never seen one quite on the ground, although sometimes it is only raised a few inches in brambles or other low-growing plants. I have many times seen nests in box trees from three to six feet high, but have only once found a Willow-Wren's nest that was not on the ground; in this case I caught the female, and sent it to Mr. Dresser to be quite sure of my identification. It has

always struck me as very curious how the nesting habits of birds change in different localities. With us the Willow-Wren almost always builds its nest on the ground; in fact, in twenty years I have only once known an exception, whereas on the Spey side last year I found as many nests in bushes, &c., off the ground as I found on it. The highest nest I saw was quite twelve feet from the ground in the ivy on a house. The Chiffchaff with us always breeds on the ground (at least, I know of no exception). Dr. Butler's experience is different. — HEATLY NOBLE (Temple Combe, Henley-on-Thames).

Tree-Creeper nesting in Roof.—During the winter we have often seen a pair of Tree-Creepers (*Certhia familiaris*) on the big trees on the lawn here, and once or twice they were seen running up the side of the house, which is sand-dashed. On May 17th, when on the lawn, I saw one settle on side of house, and run up the wall; there is a greenhouse standing from the house, the top of the wall being covered with sheet lead, and the bird went in under this. I procured a ladder, and found a nest built on top of bricks against the wall of house. It is within four feet of a bedroom window, and close to the top of one of the drawing-room windows: a snug, dry, and warm place, but an unusual one for a Tree-Creeper.—J. WHITAKER (Rainworth, Notts).

Abnormal Nesting Place of Spotted Flycatcher.—Last year (Zool. 1898, p. 429) I recorded the finding of a nest of the Spotted Flycatcher (*Muscicapa grisola*), built inside that of a Swallow's. It may be interesting to readers to know that on May 11th last, in an old cowshed three hundred yards from the gruff-hole, I again found a nest of the Swallow tenanted by Flycatchers; a frail nest was built inside containing three eggs. The sitting bird flying from the nest led to the discovery. It seems remarkable to me that in the same small area, on two occasions, a pair of these birds should occupy a nest of the Swallow for the rearing of their offspring. Of course, I do not know whether they were the same pair of birds. Would this habit be inherited by the offspring? — STANLEY LEWIS (Wells, Somerset).

Hobby in Westmoreland.—I am sorry to say that a poor little Hobby (*Falco subbuteo*), an immature bird, was shot by a keeper in Malinethorpe Wood, Westmoreland, about the 24th of August. The Hobby is of rare occurrence in Lakeland; I do not recall any other specimen as having been killed in Westmoreland, though a few Cumbrian Hobbies exist in local collections. It is possible, nevertheless, that the recent specimen (which I have added to the Carlisle Museum) may have been bred in the district in which it came to its untimely end. Our excellent taxidermist, Mr. Hope, of Penrith, informs me that his father once killed a pair of Hobbies at their

nest in Penrith Beacon, and took the eggs from the nest. The eggs were to be seen in a local collection until quite recently.

May I venture to remind distant friends that after Dec. 31st my address will be the Rectory, Pitlochry, Perthshire? I mention it to obviate the necessity of letters being redirected. I shall continue to work for the Carlisle Museum, and to record notes of Lakeland animals; but I shall no longer be an actual resident in Lakeland. — H. A. MACPHERSON (Allonby, near Maryport).

Black-game in Suffolk. — I have been informed by Sir Cuthbert Quilter that a Blackcock (*Tetrao tetrix*), in immature plumage, was killed by his son, Mr. Eley Quilter, during a Partridge drive on the Cliff Farm, near Woodbridge, about two miles south-east of the town, at the end of last October. It would be interesting to know the history of this juvenile wanderer. — E. A. BUTLER (Plumton House, Bury St. Edmunds).

The Moor-hen (*Gallinula chloropus*) nesting in Trees. — During the past breeding season I found three nests of this species in pollard trees from six to ten feet above the water, all containing eggs. Mr. Summer's gamekeeper in this neighbourhood has lately informed me that on Lord Ilchester's estate he has taken the eggs of the Moor-hen from an old Ring-Dove's nest twenty feet high, in a spruce-fir tree. — STANLEY LEWIS (Wells, Somerset).

The Storm-Petrel (*Procellaria pelagica*) flying at Light. — On the night of Nov. 24th, whilst exercising search-lights in Gibraltar Harbour, two Storm-Petrels flew into an officer's cabin through the port. The cabin was situated just beside a search-light, and by it the birds were probably half-blinded, which accounts for their action. The night was dark and stormy. I have never heard of this species behaving in this manner previously, nor have I ever seen it about Gibraltar before. — K. HURLSTONE JONES (H.M.S. 'Repulse,' Channel Squadron).

[I captured a specimen of this species on board the U.S. 'Norman,' when returning from the Cape in 1896, at the commencement of the month of October, near the Cape Verde Islands. It was also probably attracted by the many lights, and was easily caught. — ED.]

Notes from Rainworth. — Late Stay of Fieldfares: We had Fieldfares (*Turdus pilaris*) here at Rainworth till May 15th. Common Scoter: A male of this species (*Edemia nigra*) was shot on the large piece of water at Lamb Close, near here, in September, by Mr. Barber. Rough-legged Buzzard: One of these fine birds (*Buteo lagopus*) was about here in March for six weeks. I saw it several times near the house over the lake, and admired its beautiful flight. One time two Herons were on the

wing near it, and looked about the same size. — J. WHITAKER (Rainworth, Notts).

PISCES.

Anchovy at Yarmouth. — A very fine example of the Anchovy (*Engraulis encrasicolus*) was taken in a drift-net amongst Herrings, and brought in on Oct. 2nd; length, $7\frac{1}{2}$ in. Dr. Day says it rarely exceeds $6\frac{1}{2}$ in. Another about the same length was brought to me salted on the 31st. Although the numbers of Herrings taken off Yarmouth this season have beaten the record, fewer stranger fishes, *e.g.* Shads, Pilchards, and even Sharks, have been caught or seen than in other years; and a similar remark applies to the Cetacea. — A. PATTERSON (Ibis House, Great Yarmouth).

Food of the Eel. — An excellent observer, Richard Holme, of Rusland, informs me that he has seen an Eel swallow a fresh-water Lamprey, tail first. He has also more than once watched an Eel attempting to catch small Trout (or other young *Salmonidæ*) by snatching at them as they passed by. Once he saw an Eel actually catch one. These notes refer to the stream known as the Rusland Pool. — CHARLES F. ARCHIBALD (Rusland Hall, Ulverston).

[According to Capt. Williamson, an old well-known angling author, "Eels swallow fishes head-foremost." — ED.]

EDITORIAL GLEANINGS.

WE recently (*ante*, p. 478) drew attention to the forthcoming publication of a series of volumes on the Fauna of South Africa, and mentioned that the first volume would be on the Birds, and written by Dr. Stark. News has unfortunately just been received of the violent death of Dr. Stark, caused by a shell at Ladysmith during the Boer bombardment of that British town. Dr. Stark was the eldest son of the late Mr. John Cowell Stark, of Torquay. He was educated at Blundell's School, Tiverton, and at Clifton College, with a view to becoming a civil engineer. Comparatively late in life, however, he determined to become a doctor, and he matriculated at Edinburgh University. For ten or a dozen years he had been prominently identified with life in South Africa. He had a practice at Capetown, and he was well known and respected at the Cape and in Natal. The deceased gentleman had travelled extensively, not only in South Africa, but in Spain, Morocco, Turkey, and other countries. He was an ardent naturalist and accomplished ornithologist, and possessed a splendid collection of birds of prey. Dr. Stark was recently in England, and only returned to South Africa last September. Whilst he was at Durban war was declared, when he volunteered for service in assisting the wounded, and was placed in charge of an ambulance.

A WELL-KNOWN and highly respected officer will be missed from the entomological library of the British Museum in the person of Mr. John Saunders, who has been connected with that establishment for nearly sixty years. In 1840, Dr. J. E. Gray applied to the schoolmaster at Hounslow for a boy who could "write a good plain hand," and young Saunders, though barely thirteen years of age, was nominated for the post, and entered on his duties in September of that year. The British Museum—then Old Montagu House—much impressed the young assistant by the fine old entrance-gate with its massive iron knocker, and on each side of the gate a sentry-box and a grenadier with fixed bayonet. There was also a gateporter to open and shut the gate during the day, and three watchmen on duty during the night, who alternately every hour from 9 p.m. to 6 a.m. walked round with club and lantern, and called the hour, "All's well." His first occupation was in assisting Dr. Gray in soaking off the Mollusca from old tablets of a very miscellaneous size, and placing them on new ones, previously to their being properly named. In 1847 he was appointed to

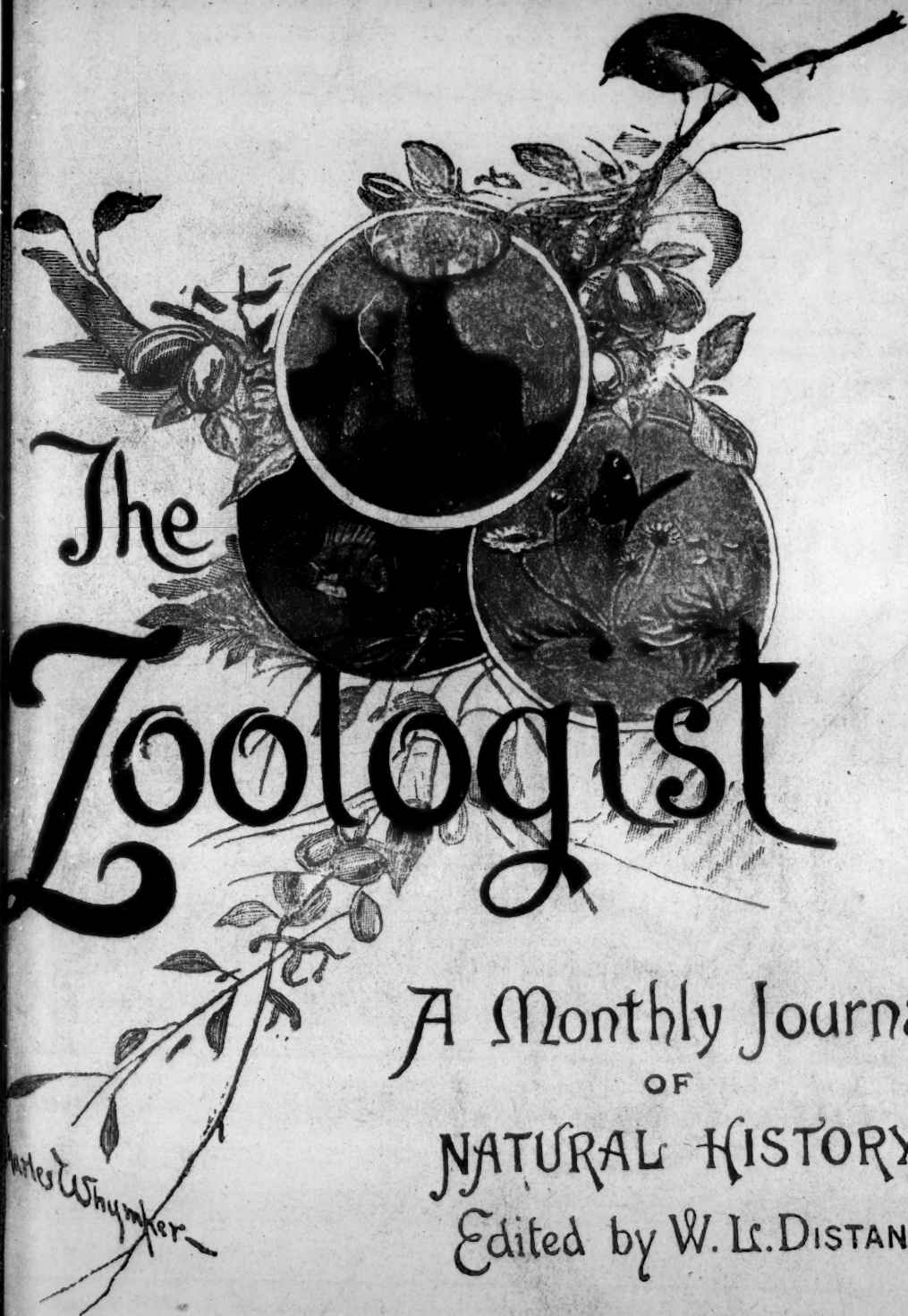
overhaul the osteological collection, registering, &c., till 1857, when he was transferred to the insect room, and took charge of the library, at that time very small compared with its present dimensions. Thus Mr. Saunders has largely witnessed the evolution of our Zoological Museum, and retires on a moderate pension incidental to a never highly paid position. He has always been greatly esteemed, and the Museum staff presented him with a testimonial on his leaving, which was handed over to him in appreciative terms by another veteran of the establishment—Dr. A. Günther.

ON the occasion of the unveiling of the monument dedicated to Johannes Müller, which took place on Oct. 7th at Coblenz, the daughter of the celebrated zoologist presented to the Stadtbibliothek fourteen volumes of drawings, containing upwards of nine hundred zoological sketches made by her father in the years 1850–1854 in various countries.

MR. HENRY O. FORBES, the Director of the Liverpool Museums, has issued his Report upon the Scientific Expedition to the Island of Sokotra during 1898–1899, which, under the generous auspices of the Royal and Royal Geographical Societies of London, and of the British Association, in conjunction with Mr. Ogilvie-Grant, representing the British Museum, he undertook at the direction of the Committee for investigating and making collections of the natural history of that island. The Director truly observes, "that among scientific circles, especially among geographers and biologists, there has everywhere been expressed the warmest appreciation of the liberality and public-spirited action of the Liverpool Museum Committee and the Council in taking part in the exploration of Sokotra."

The share of the results of the expedition which comes to Liverpool may be summarized as follows:—Of mammals, there are examples of one or two species of Rat, of one species of Civet Cat, of one species of Bat, and of the Wild Ass. Of birds, there are some three hundred specimens, out of which seven species have been diagnosed as new to science; a large series of reptiles has been acquired, which contains one genus and eight species new to Herpetology. Numerous Scorpions, Millepedes, and Spiders have been obtained, among which there turn out to be at least one new genus and seven new species; the land-shells number several thousands, of which Mr. Edgar Smith, of the British Museum, has already described eight species as new to his department of Zoology. Of insects—almost the whole of which were collected by Mr. Ogilvie-Grant—there are several thousands, which in butterflies have included a new species of a very beautiful and large *Charaxes*.





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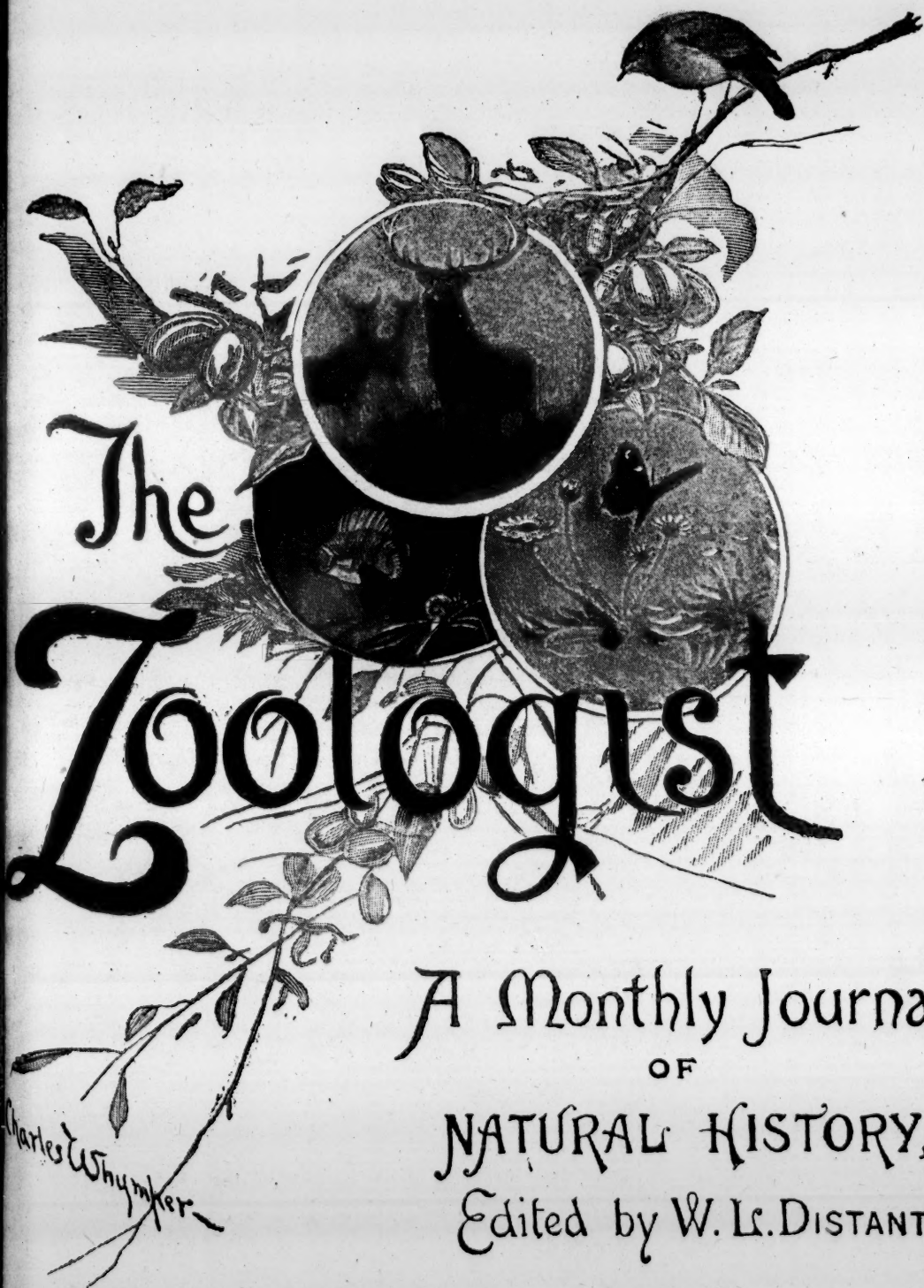
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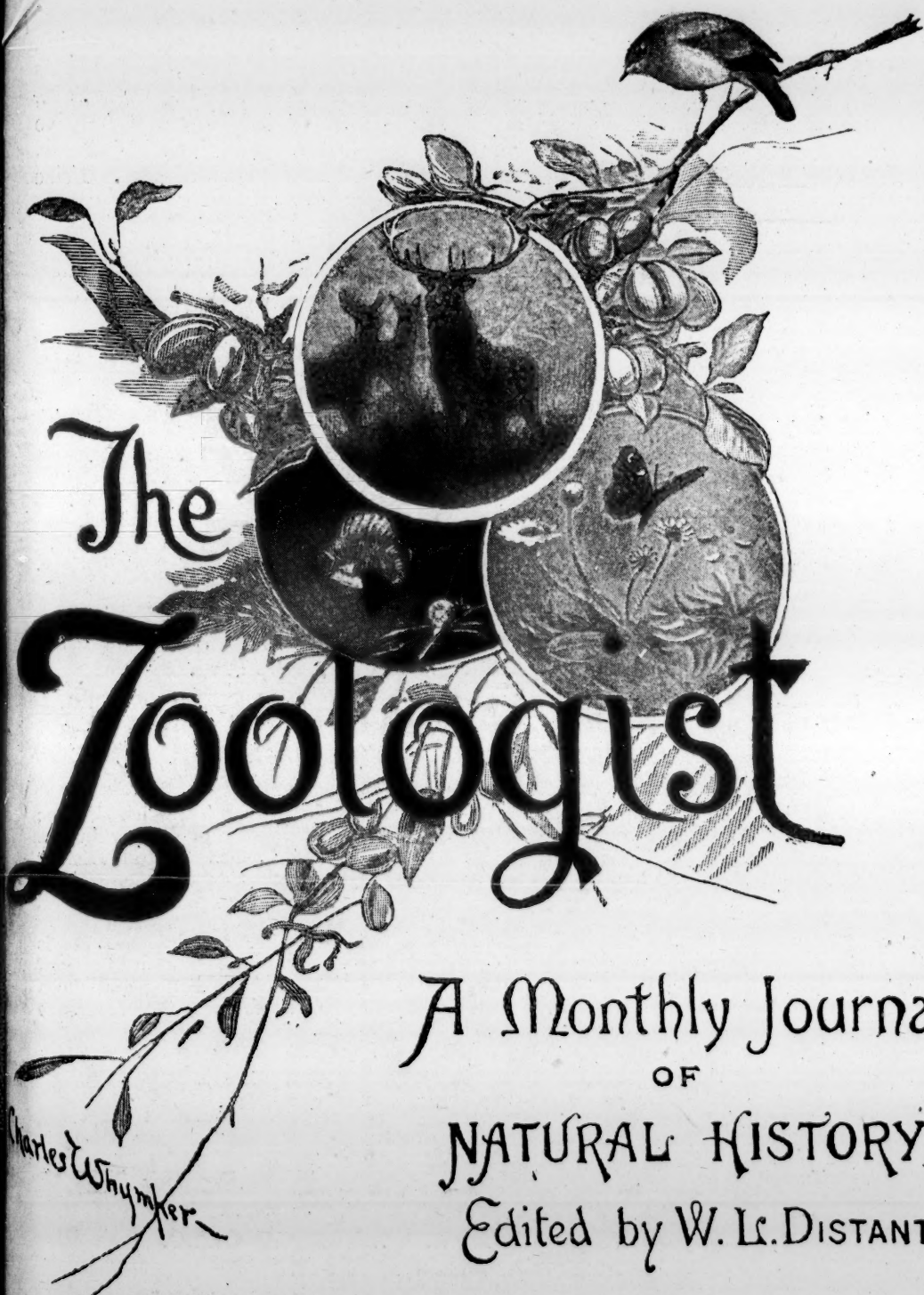
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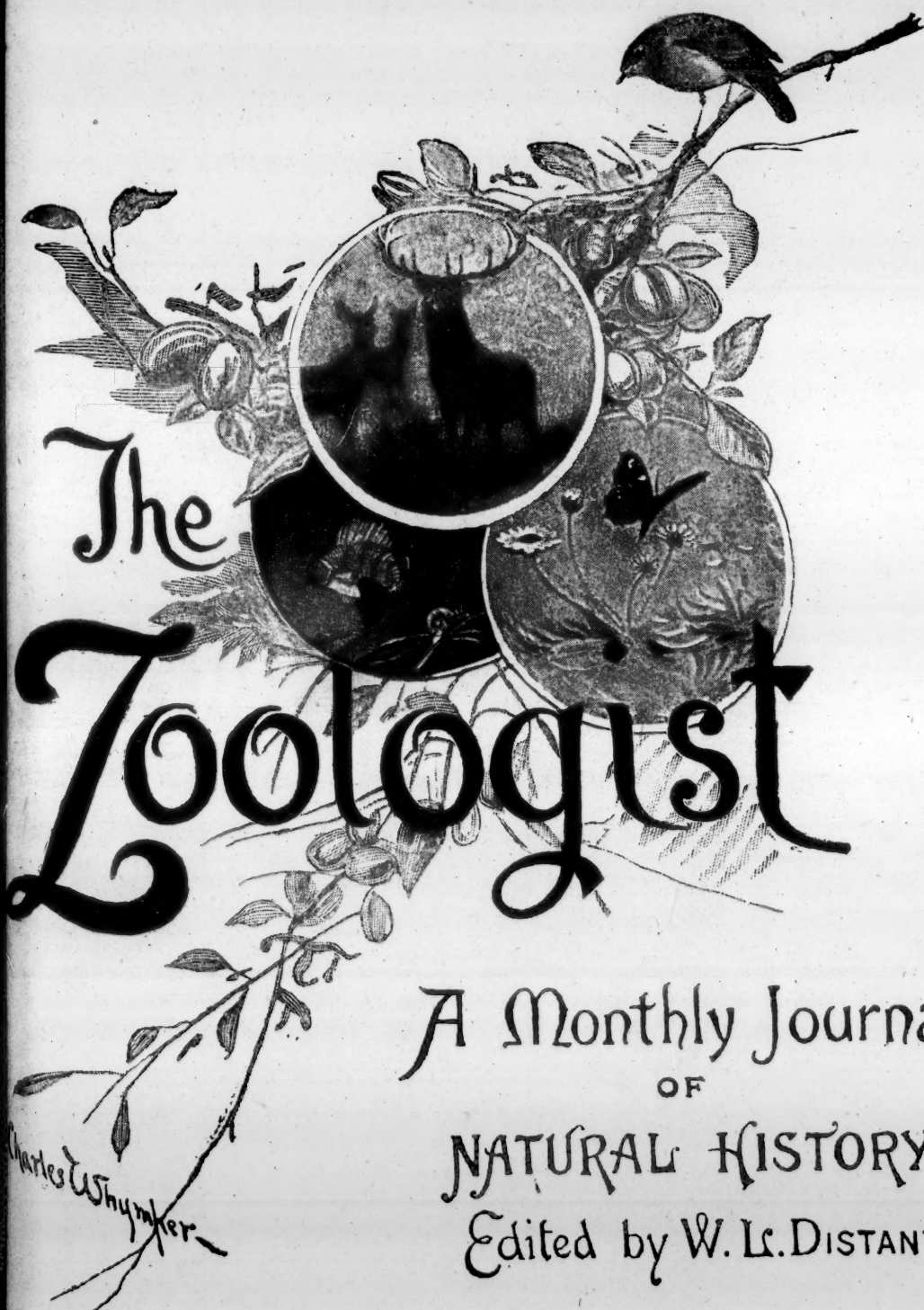
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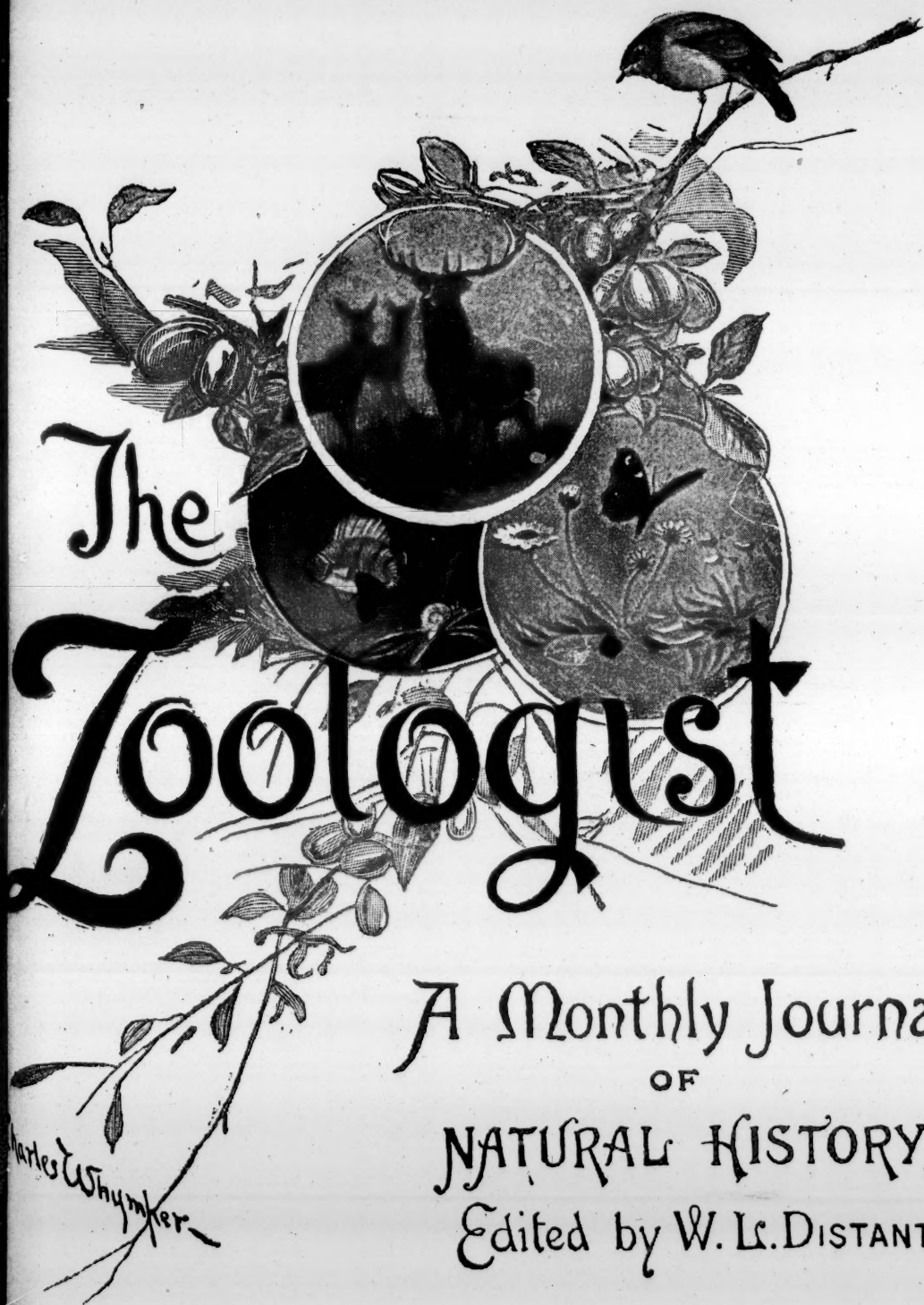
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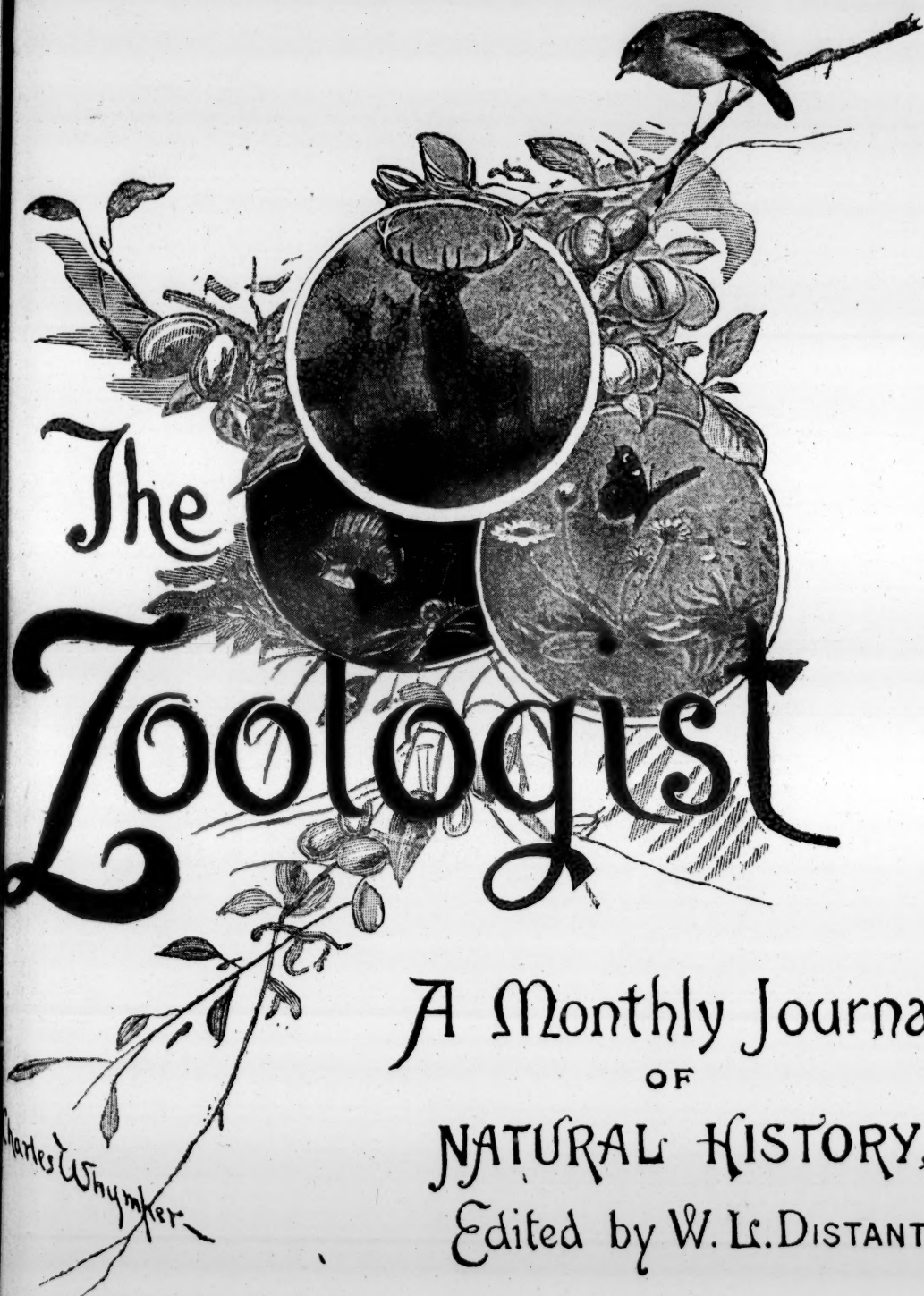
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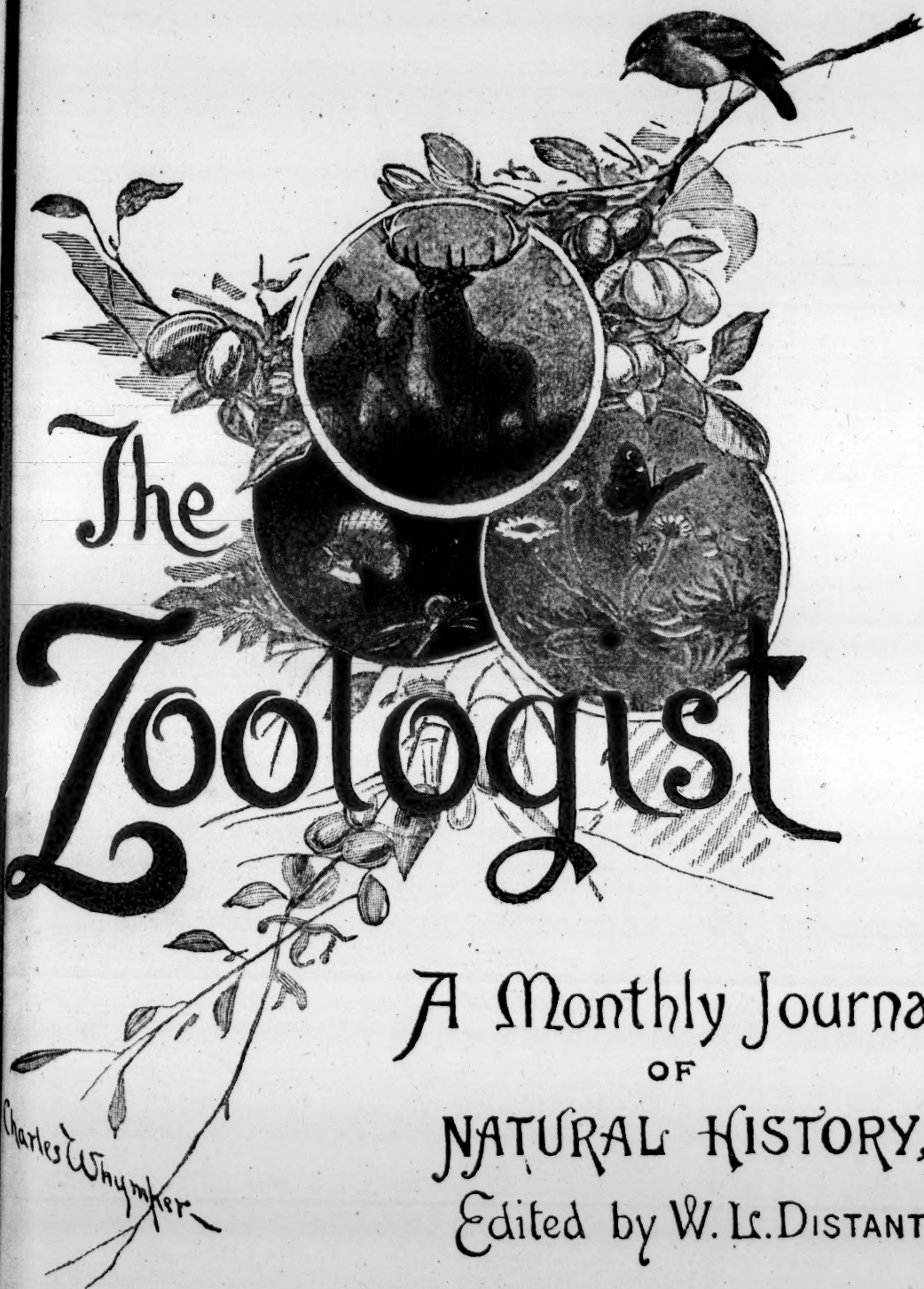
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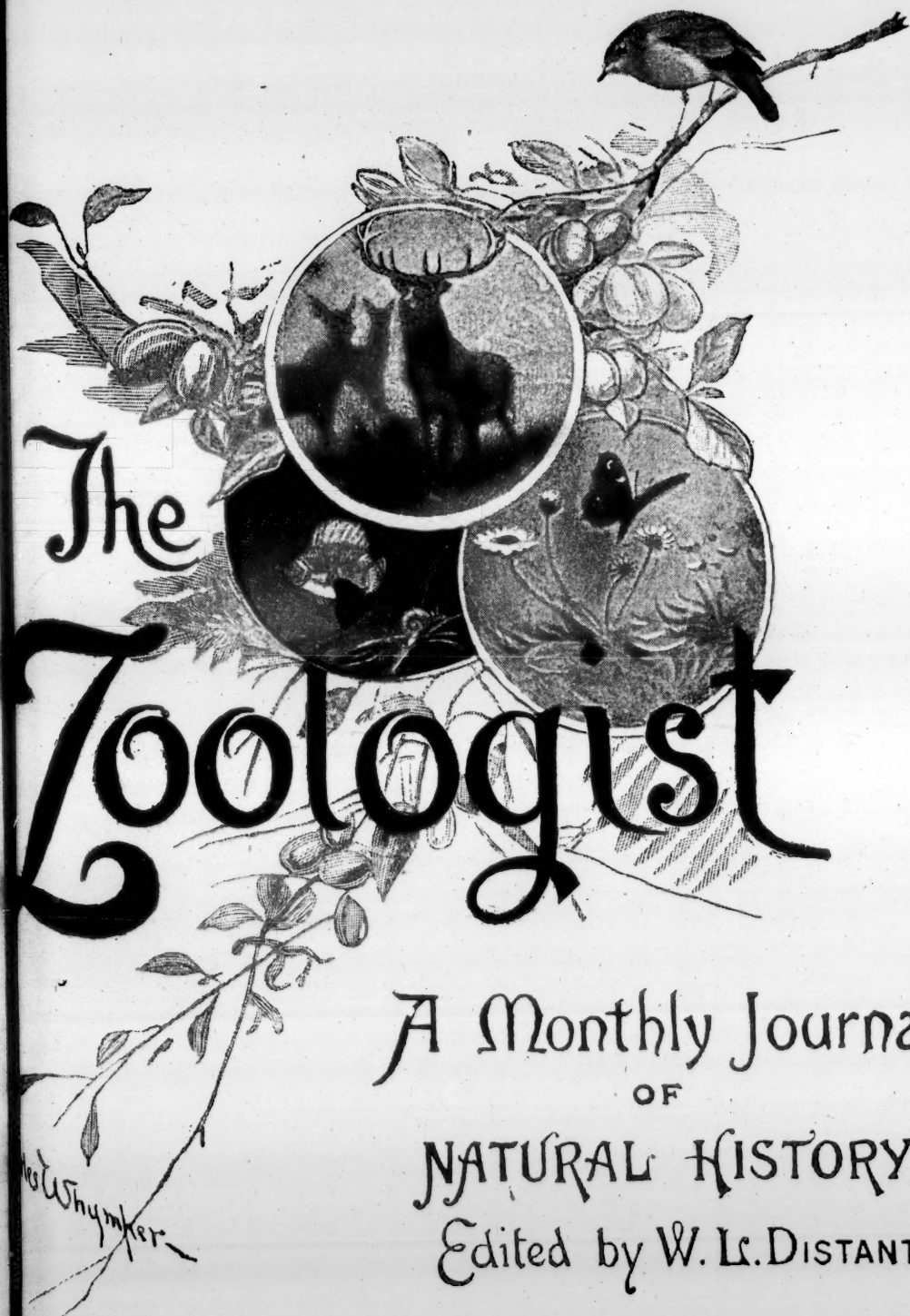
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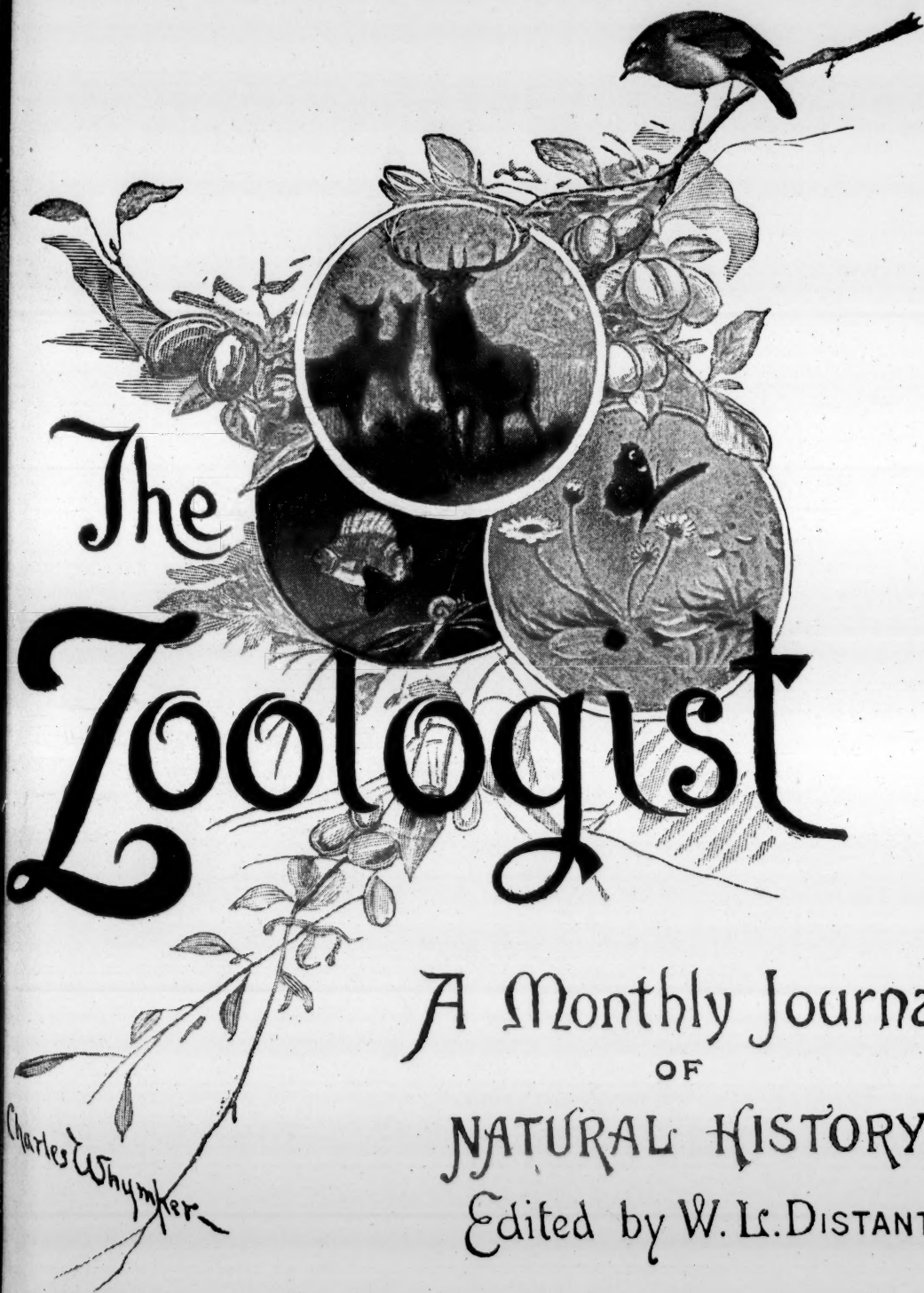
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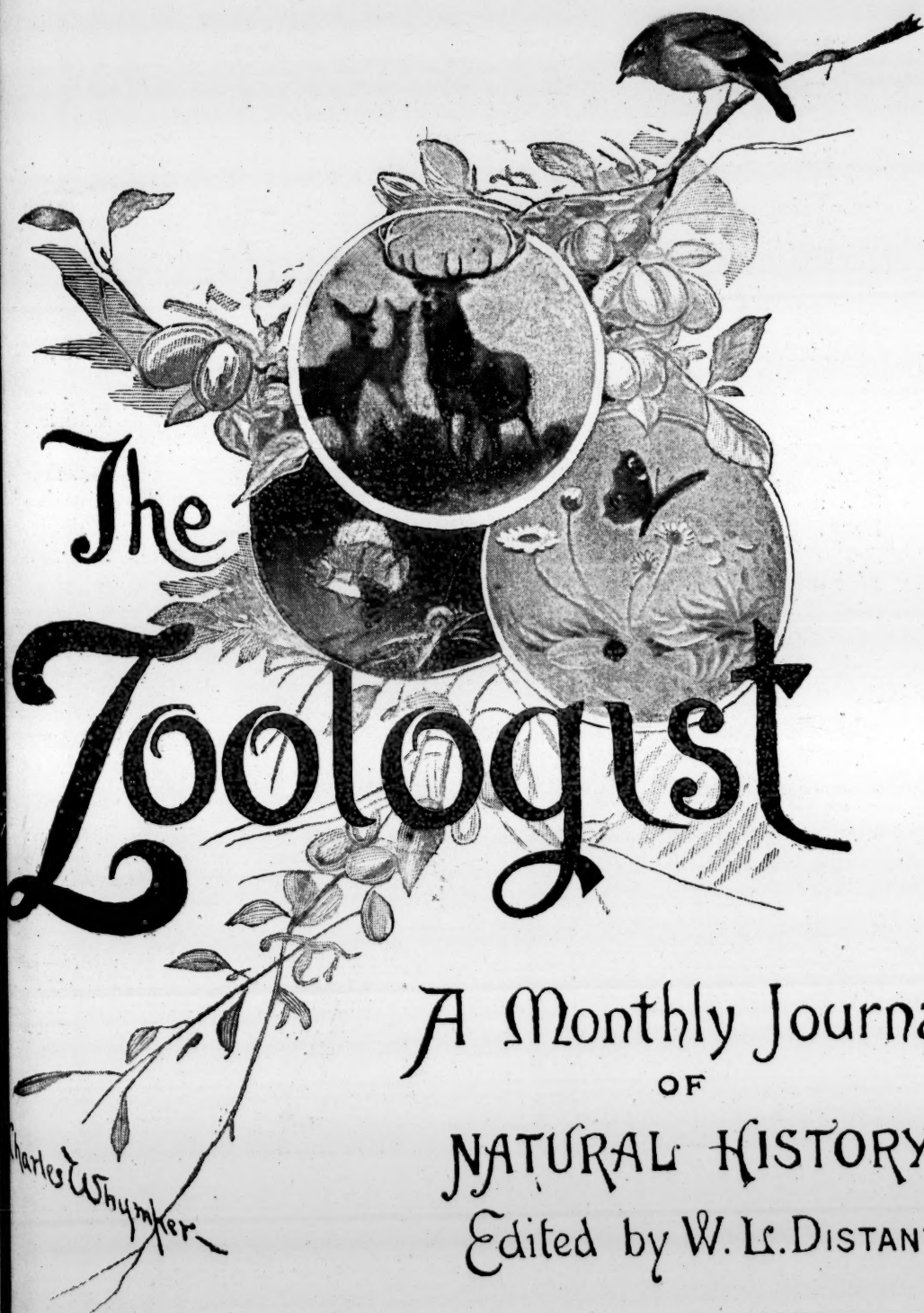
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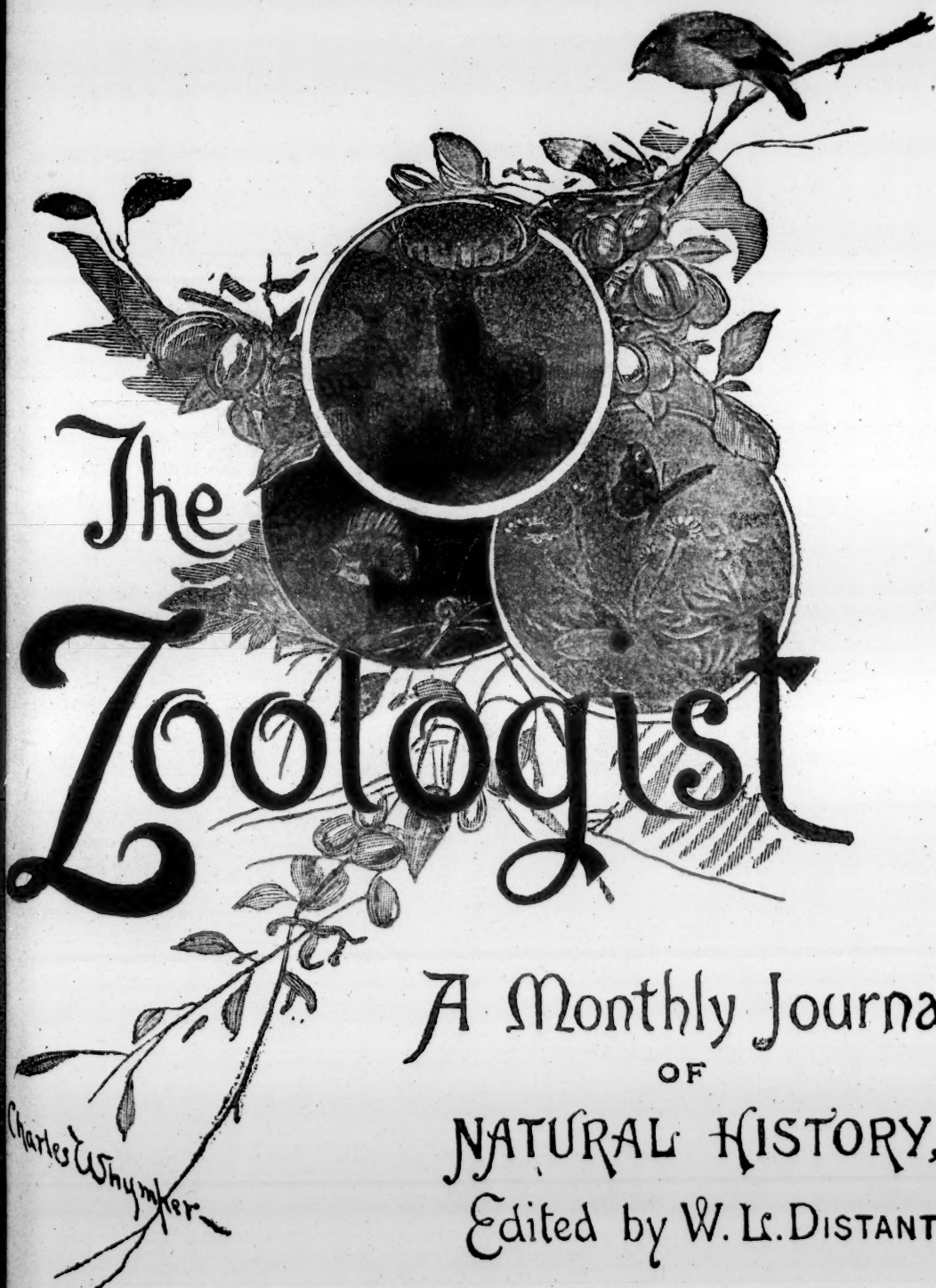
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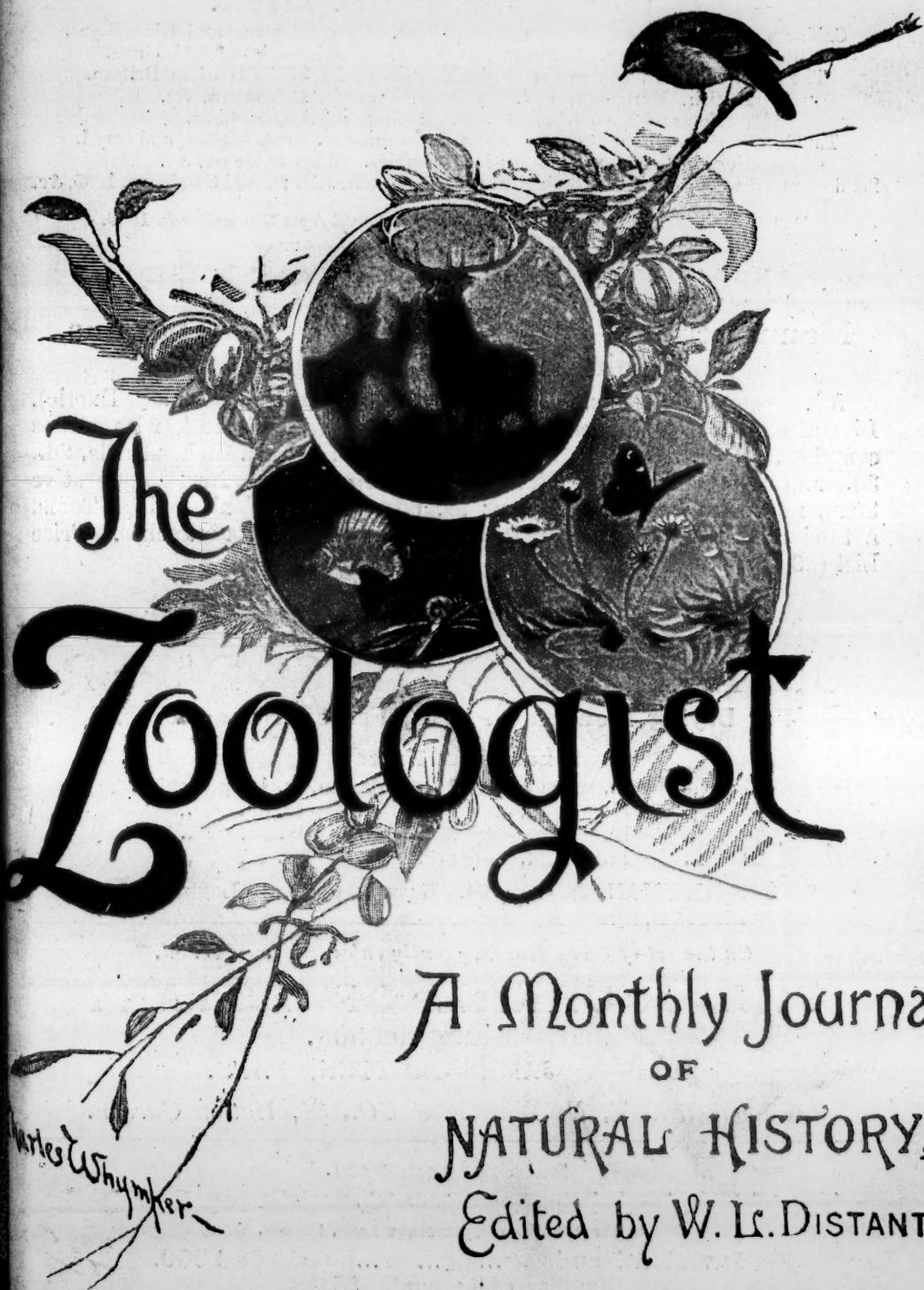
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